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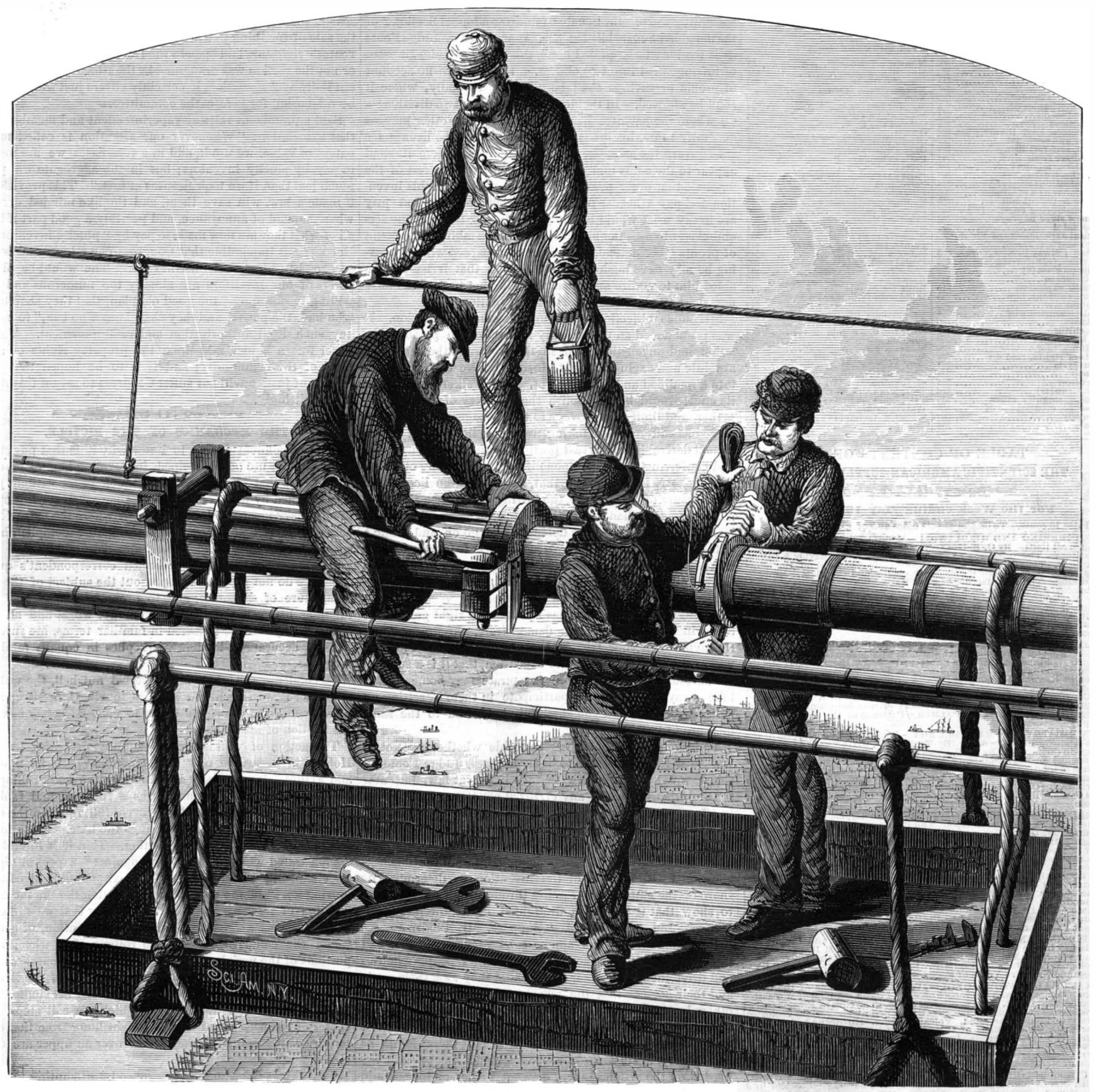
COMBINING THE STRANDS OF THE EAST RIVER BRIDGE CABLES.

In tracing the progress of making the superstructure of the East River Bridge, it will be remembered that we began with the manufacture of the steel wire, and afterwards explained how the great coils were unwound, and the wire carried across the river from anchorage to anchorage, to and fro, until it had been passed a sufficient number of times to make a strand. The wire, we stated, weighed one pound per eleven feet, and 261 wires made one of the strands, nineteen of which laid together constitute one of the four great suspension cables. These immense ropes are about 3,500 feet in length each, and extend between the eye bars of the anchorages. When finished they will be sixteen inches in diameter, and their object is to support the weight of the superstructure. Since last summer the work of making the strands has steadily progressed until now twelve belonging to each cable are finished, and a thirteenth is nearly ready for lowering into place upon the saddles on the piers. A sufficient number, therefore, has been completed to allow the assembling to begin, and to the first steps of this important operation we devote the present article and illustrations.

Each cable is composed of two portions, the core and the exterior envelope; the former consists of seven, the latter of twelve strands. When finished this distinction will be obliterated, as all the strands will be bound into one homogeneous cylinder, the object being to protect the wires from effects of the weather, and allow of the convenient attachment to them of the other portions of the bridge; otherwise the strands might lie loosely side by side as they now do. This binding will exist everywhere, except directly on the saddles, and here it is omitted for the obvious reason of the immense labor which would be required to lift the entire cable from the grooves, and which would serve no useful purpose. It follows consequently that, in placing the strands over the saddles, due regard must be had to their ultimate position in the cable, so that, referring to Fig. 2, page 306, the lower-most strand, 1, of the envelope is first laid, then the pair marked 2, then pair 3; above these come the seven strands, in similar order, which go to make up the core. To enable the distinction to be clearly made between core strands and envelope strands, we have made the former black in Figs. 2 and 3.

It will be remembered that the strands are secured by their bights being passed over heavy pins which go through the eyes of the anchorage bars, and also that, after each strand was finished, wire wrappings were placed around it at short intervals apart. Before assembling those strands constituting the core, all these wrappings, excepting those on the center strand of the seven, are removed. Then, at a point twenty-one and a half feet distant from the eye bar ends, lashings are clapped on first upon the lower pair of core strands, then upon the three next above, and finally upon the upper pair, Fig. 3, the object being to draw the strands individually together horizontally. To haul them up close vertically, a rope is attached to one of the envelope strands, 2, Fig. 3, brought up around all the core strands, up again to form a long bight, around the core strands again, and finally secured

[*Continued on page* 306.]



CABLE MAKING ON THE EAST RIVER BRIDGE.

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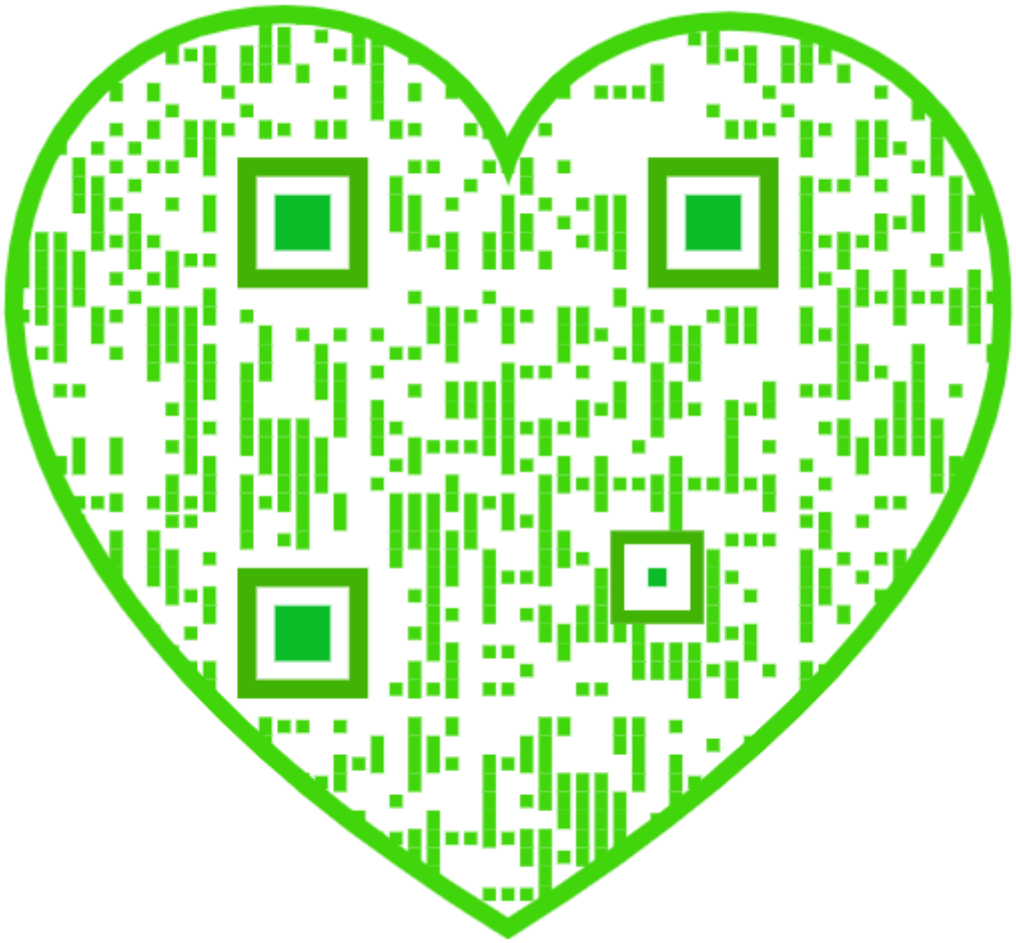

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A RAID ON INVENTORS' RIGHTS.

As the patent law now stands there are two ways for a patentee to recover for an infringement of his rights. He may proceed at law and recover damages, that is, what he has lost by means of the infringement: or he may proceed in equity to recover the infringer's profits, or the saving effected by the use of the pirated appliance or process.

These two courses are adapted to two entirely different classes of patents, though in many cases the patentee may elect which course he will pursue in case of infringement, both being open to him Where the value of the patent consists wholly in the right to make and sell the thing patented, the rule of damages is applicable. Where the value of the patent consists wholly in the use of the patented appliance or process, cases of infringement go to courts of equity, and the amount of the patentee's money recovery is measured by the infringer's gains through the infringement. In an action at law the plaintiff recovers actual damages. If he has been in the habit of granting licenses to make and sell his invention, thus establishing a market value for the right, such license is made the primary (but not the absolute) basis for measuring damages. In case the evidence on this point is not sufficient to determine a just measure for damages, the court or jury determines the damages from all the evidence in the case. Where the profit of an invention accrues only to the user of it, the doctrine of equity is that a trust exists in behalf of the inventor or owner of the patent, for whose benefit the user of the patent is a trustee; and whatever money an infringer derives from the use of the invention he is bound to pay over to the owner of the patent. This even where the infringer fails to make a profit by the infringement, since his misuse of the patent may be more seriously injurious to the patentee than its proper and profitable employment could possibly be.

To obviate certain practical difficulties in the working of this last rule—obviously also to prevent the enactment of something worse—the Senate committee adopted Section 2 of the amended Senate bill No. 300. As analyzed by Judge Foote (it is too long to be quoted here), this section divides all cases of infringement into two classes. First, where no account of profits or savings shall be allowed; secondly, where it shall be allowed. In the first class there are two divisions—(*a*) where the patentee has elected to license other persons generally to use his invention, in which case the license fee is to govern the assessment of damages; (*b*) where it shall appear to the court and jury that it is for the interest of the patentee that other persons generally should use his invention and pay a license fee therefor: then the court and jury are to say what would be the proper license fee. In the second class of cases the bill provides that in taking an account of profits "the defendant shall not be charged with any saving he may have made, if he shall show that it has not enabled him to realize an actual profit in that part of the business connected with the use of the invention."

Strenuous objections were urged against this section. It was pronounced an unnecessary innovation in patent legislation, and unconstitutional, in that it turned the patentee's absolute and exclusive right, during the life of the patent, into a qualified and limited right. Mr. Walker claimed that its effect would be to abolish the recovery of profits altogether, and limit the recovery to the damages which the patentee has suffered, thus taking away the lion's share of the benefit derivable from a vast portion of the inventions made and conferring that share upon infringers. Among other objections, Mr. Hubbel urged that, in making the license fee the measure of the damage, the infringer would be placed on a better footing than the parties taking a license. "It would be simply a license to the defendant to go on and pirate a patent, and be subject to no greater license fee than was paid by the most favored parties of the patentee, who had risked their capital and everything they had, perhaps, to demonstrate whether or not it was a success. . . . What right has Congress, when a man has an exclusive right granted, to come in and say, 'If you demonstrate, through capital, through any of your friends, through any influences which will enable you to carry it into execution, that it is a successful business matter, therefore any pirate may come in and take away your profits or participate in them by setting up an infringement, and you shall only hold him to the same measure of license fee?'"

To leave it to judge or jury to decide whether or not it was to a man's interest to issue licenses, Judge Foote insisted, was not only a new feature in patent law, but new to the jurisprudence of any civilized country. Even worse in effect were the provisions forbidding the accounting of profits where the infringer did not make a profit on his entire business, and requiring the profit, where it was allowed, to be determined by an investigation into all the business connected with the use of the invention to determine its share of the gains. After going through the whole section to show that it had been draughted in the interest of infringers, Judge Foote said: "Suppose, Mr. Chairman, we had a band of robbers amongst us of great wealth and power; that they were accustomed to enter people's houses and drive them from their homes, that they took their cattle and their horses—that the wheat, the corn, the cotton, that others by their labor and expense had produced, they should appropriate, and to meet such an emergency you should pass an act like this second section, to wit, that there should be no recovery against these robbers beyond the price in the market of the articles taken, or what a court or jury should say ought to be a market price; that in case of an accounting nothing should be recovered unless the robbery had been profitable, and that the court should determine what proportion of profits was due to the robbery and what to other elements; and, finally, you should make all legal proceedings against them so onerous and expensive that none but very rich men could contend with them—would it not be justly said that you had promoted fraud and wrong, and discouraged industry, and injured all the best interests of society? I cannot view this section in any better light, in reference to the rights and interests of patented property."

In spite of such objections as these, the Senate committee saw fit to adopt the obnoxious section; most probably, as we have already intimated, as a compromise; for the enemies of the patent system were striving to introduce features even more vicious and disastrous in their tendency. Greater success has attended their efforts before the committee of the House. After a strangely brief consideration (less than five minutes, it is said) that committee adopted, April 26, a substitute for this second section (S. 300; H. R. 1,612), which seeks to reduce still more the limited right in his invention which the original allows the patentee. It provides that in all suits for infringement the measure of the plaintiff's recovery shall be the same both in law and in equity. That measure is the license fee, as established either by a reasonable number of transactions applicable to the case at bar or by a jury; and no evidence on account of the economy of the pirated invention is to be admitted to help the jury to determine its value. The only exception to the rule is "in cases where the defendant has made an actual profit from selling the thing patented or the product thereof; and in such cases the proportion of the actual profit of such sale due to such infringement shall be determined, and that proportion of such actual profit shall be the measure of the plaintiff's recovery."

It will be readily seen that this device puts all inventors practically under the thumb of infringers; and in the large number of cases in which the value of a patent consists in the use of the invention, as in railroading, and not in the sale of the thing patented or some product of it, the inventor's rights are laid open to the freest invasion. Whether or not the section was draughted by the attorney of the Western Railway Association, it certainly covers just what he has been laboring for before the committee.

Said a prominent railway superintendent and member of that association: "Whenever our attention is called to a patent of value, we use it, and in a few cases we are made to pay by plucky inventors; but in the aggregate we pay much less than if we took licenses at first." This provision, if made a law, will save them, and the like minded everywhere, no end of annoyance, and possibly a good part if not all of what they are now made to pay by "plucky inventors." But it seems impossible that Congress can adopt a measure so grossly unjust and mischievous. The would-be plunderers of our inventors are already too numerous and too willing to act upon "the good old plan, that they shall take who have the power, and they shall keep who can," to need any such legal authorization and encouragement. There never was a bolder raid upon the property rights of any class of the community; and it is to be hoped that the friends of justice will not suffer Congress to act on this matter unwittingly.

THE MECHANICS OF THE BICYCLE.

A correspondent wishes to know why it is that power is gained by the use of a velocipede in traveling long distances; or how it is that one can travel so much faster without getting fatigued by using a velocipede than when relying upon the ordinary means of locomotion; or where the extra force comes from that enables a velocipedist to accomplish high speeds, totally impossible to the pedestrian.

In answering our much esteemed correspondent's questions, we do not propose to open out the subject of the nomenclature of dynamics, and to pronounce upon the distinctions between force, power, energy, work, and all the rest. The questions, as asked in familiar terms, are susceptible of accurate and exhaustive replies in equally familiar language.

To condense the whole into a verbal nutshell, the walker or runner is wasting his strength in moving himself up and down, while the velocipedist has to contend solely against the friction of his machine.

The action of walking, as so happily described by Dr. Holmes in his article on "The Human Wheel; its Spokes and Fellies," is essentially a rolling one, the body rolling or rocking on the ball of one foot as a fulcrum, and rapidly moving the other foot ahead to prevent falling when the center of gravity of the whole overhangs the base. It is a forcible, perilous, and complex operation. That it is forcible is demonstrated whenever we "run against" a post at night. Its complexity is illustrated by the extreme difficulty in acquiring it; while the peril of the operation lies in the combination of its force and difficulty. Now that we are used to it, it seems a very easy and simple operation, of course—and the comparison with the rolling of a wheel with portions of the periphery removed is not a bad one—save in one thing, which is where the genial Autocrat of the Breakfast Table neglected dynamics to help along his simile. At each of those swinging motions which we call steps, the center of the wheel, and all the weight hung from that center, are lifted bodily as they swing over an upper arc of a circle.

That this is the case may be proved by attempting to walk along under a board placed at such a height as to exactly touch the top of the head. The rising of the whole body to

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a height nearly equaling that to which the heel is raised in walking causes the board to hit the head, or the head to strike the board, whichever you may call it.

Now in walking a mile, or 5,280 feet, on level ground, in 20 minutes (ordinary gait), and taking military regulation steps of 28 inches each, one lifts the body 5,280 × 12 ÷ 28 = over 2,363 times in the 20 minutes. This means that the body is lifted 2,363 ÷ 20 = about 118 times per minute. If the rise of the center of gravity is but one inch, and the body weighs 160 lbs., there will be 118 × 160 ÷ 12 = 590 minute foot pounds, = nearly $\frac{1}{50}$ of a horse power, wasted just in lifting the body up and letting it come down again without any useful effect. In other words, the same amount of force expended in walking up 118 treadmill steps, each an inch high, in a minute, would develop $\frac{1}{50}$ of a horse power.

If, now, one were to walk so that the head and shoulders, as indicating the vertical position of the center of gravity, should not rise and fall with the steps, all this force would be saved; and if the muscles were of steel, and the motive power of the whole a spring, then walking on a level would resolve itself, very largely, into a question of overcoming the friction of the feet and joints, etc. But unfortunately (perhaps), the muscles are dependent, for their contraction and strength, upon the action of the motor nerves, and these last upon the mysterious chemistry, electricity, or whatever it be, of the brain and the nerves of volition. Thus, in holding the arm or the leg out steadily in any given position for even a short length of time, although there is no work being done, dynamically speaking, there is, to the muscular system, what amounts to the same thing, whether caused by action or by continued restraint—fatigue, followed by pain and by temporary paralysis if too prolonged—the limb dropping when the muscles refuse to perform their office.

There is thus much more physical fatigue caused by walking than corresponds to the 590 minute foot pounds, the foot pound account increasing arithmetically only, while the nerve tax mounts up in geometrical ratio. It is generally considered more "fatiguing" to come *down* a very long flight of steps, say those in Trinity Church spire, although lifting no weight, than to climb up, especially if one has taken no rest at the top.

We will now consider the work done by the velocipedist on a smooth and level mile course. Firmly seated, he causes the muscles of his leg to turn a wheel, and to do that only. His whole body is never lifted; and in one four-wheeled variety having treadle bars with reciprocating horizontal motion, even the weight of the legs is not raised, as in the common bicycle.

If an ordinary spring balance were fastened to the velocipede with rider in the seat, and the whole was hauled along, the spring would indicate in pounds the "draught," or the resistance due to the friction of the moving parts of the machine, and to that of the ground and the tires. A bicycle with driving wheel 3 feet in diameter would make 5,280 ÷ (3 × 3.14) = about 528 revolutions per mile; and if we suppose the mile to be made in 20 minutes, the wheel has made 528 ÷ 20 = about 26 turns per minute. If the crank is 4 inches long, the vertical stroke of the foot is 8 inches, but the center of gravity of the limb, which is located in the thigh, has been raised only about half that, or say 4 inches. Supposing the legs to weigh 55 lbs., the work in lifting the legs is 55 × 4 × 26 ÷ 12 = 476 foot lbs.

But every pound of this, less the ridiculously small amount lost in overcoming the friction of hip and knee joints, etc., has been utilized on the down strokes of the cranks as driving force; whereas, in walking, the fall of the whole body (which is utilized in treadmill work) is wasted.

We thus see that the velocipedist in traveling does less lifting than the pedestrian, and does not waste that force. He also strains the muscles less, and hence can keep it up longer and go further than if on foot; or he can "speed up" without getting fatigued by reaching the limit of endurance of the muscles and their motor nerves.

Furthermore, the velocipedist is apt to choose a better track than if walking.

A case in which the leg power is so employed that the velocipedist wastes the, say, 478 foot pounds used in lifting his legs, but expends none in lifting the body, is where he sits in a wheeled frame after the style of the baby go-cart, and propels himself and the vehicle by pushing with his feet against the ground. If he were to sit in such a frame and haul himself along by winding up, on a drum worked by foot cranks, a rope attached to a fixed point ahead, the power expended in lifting the legs could be utilized on the down stroke, as in the regular bicycle.

We think we have now answered our correspondent's questions, at least so far that he can readily "cipher out" for himself the entire interesting problem of locomotion.

CAPTAIN EADS' PROPOSED IMPROVEMENTS OF THE MISSISSIPPI AND ST. JOHN'S RIVERS.

Backed by the prestige of his magnificent success in opening the mouth of the Mississippi, Captain Eads has now no difficulty in securing the whole people as his audience when he comes forward with two more great projects for national improvements. One of these is no less important than the work already accomplished, for it aims directly at the saving of the enormous expense of constructing the new levees along the Mississippi by a means as simple, and without doubt as efficient, as the famous jetties themselves. This means is, briefly stated, to narrow the wide and shallow places of the river so as to confine its current to a uniform channel. The river naturally scours its bed out in the narrow parts and drops the sediment in the wider portions along its entire length, and wherever there is a widening there are the shoals, the islands, the snags, and the stumps which impede navigation.

To bring the wide parts to the uniform width Captain Eads proposes to cover the sand bars with brush and stone dams. These obstructions would cause a deposit of sand between them and force the waters to deepen the channel. The work should go on annually, the obstructions being gradually built higher, and finally, when the river had been brought to a uniformity of width, there would be a uniformity in depth, in current, and in transportation of sediment. This work could be much more easily accomplished than could the rip-rapping or mattressing of the banks, because it needs only to be done in shallow water. Levees are objectionable, it is argued, not because of the present amount needed for absolute protection from the near floods, for four or five millions would insure this, but it is because they must cave in at the wide places. Instead of diffusing the water by outlets and raising high levees at these points, as proposed by the United States Engineers, Captain Eads advocates its conservation—every drop of it—in one channel of uniform width, and the abolition of all the wide places, the closure of the outlets, and, if necessary, the closure of the island chutes. The United States Engineers propose to attack the bank of the river with shovels and wheelbarrow, to accommodate its anticipated elevation ten or a dozen feet higher than ever before. Captain Eads proposes to set the river to work in the bottom of its bed, as he did at the jetties, and, while deepening it for the benefit of commerce, to lower its haughty crest forever. They provide for a river carried threateningly above the land, a constant source of terror and anxiety, while he proposes that its vast volume, "in all the grandeur of its mightiest floods, shall be viewed with an admiration devoid of fear from happy homes safe above its surface."

Captain Eads' other project is the deepening of the channel through the bar at the mouth of the St. John's River, Florida. Here he suggests a system of jetties analogous to those used at the mouth of the Mississippi. He finds that there exists from Jacksonville to the sea a river basin 25 miles long and averaging one mile in width. At one end of this basin the average rise of the tide is nearly 1 foot, and at the other end 5½ feet. The average quantity of tidal water passing into and out of this basin twice a day is equal to nearly 2,000,000,000 cubic feet. This would produce an average rate of current equal to 2 miles per hour, through a channel having a cross section of 30,000 square feet, or a maximum current during average flood and ebb tides of about 4 miles an hour. With such a tidal basin, even without the additional advantage of the river current resulting from a large annual rainfall upon 7,500 square miles drained by the river, Captain Eads thinks that there would be no question of parallel jetties acting otherwise than as a certain means for deepening the channel through the bar. The inflowing waters, now nearly 3 miles wide, would be caused to traverse a channel only three or four tenths of a mile wide. The frictional resistance would thus be greatly decreased, and higher tidal oscillations would occur at Jacksonville. The river channel would, therefore, not only be deepened over the shoals in the river by a higher plane of water at high tide, but the increased flow of tidal waters through the river would deepen the bottom likewise and materially improve the navigation of the river.

THE CONFECTIONER REGARDED IN THE LIGHT OF A COLORMAN.

Should the dealer in paints for decorative purposes, tiring of his vocation, suddenly conceive the idea of exposing for sale bucketfuls of brilliantly colored, ready mixed paints as newly discovered but extremely toothsome and healthful substitutes for our present articles of dessert, as well as harmless and delicious offerings to the candy-loving maiden and child, it is quite probable that the public, with its own convictions as to "the eternal fitness of things," would promptly spurn the proffered products of this new-fledged industry, and look with extreme pity, if not contempt, on the chemist who should rashly lend his name to testimonials asserting their harmlessness. And yet, if we are to believe the testimony of "experts" recently given in the Supreme Court of Massachusetts, at Boston, the trade of the confectioner would seem, in some cases, to be separated by but few removes from that of the colorman; the paints of the latter being mixed with linseed oil, while those of the former—identical in composition—are prepared for "internal use" with the more palatable materials, sugar and starch. This, of course, is a distinction; but, as far as the health and safety of the public are concerned, with very little difference.

The trial referred to was that of a Boston firm of confectioners on the charge of manufacturing and selling candy adulterated with chrome yellow, or, more accurately speaking, chromate of lead. In view of the poisonous nature of this pigment, to which we shall presently refer, the evidence elicited from the witnesses was remarkable. A former member of the firm, who had been in the confectionery business for twenty-five years, stated that he had made a specialty of the lozenge department and had never known a case of injury to a person arising from chromate of lead, and had never heard of any complaint against it. He had always been in the habit of eating lozenges freely, and although he should probably not relish a grain and a half of chromate of lead, yet at the same time he should not consider it dangerous. One of the workmen testified that chrome yellow was used in nearly every large establishment in New York, and he, together with other workmen, had been in the habit of eating the raw article. He had no doubt that he had eaten between one and two grains at a time and never considered it dangerous to the extent it was used in making lozenges. One of the members of the firm testified that he was familiar with the confectionery business both in this country and in Europe; he had always taken the greatest precautions to have lozenges made pure (?), and, to the best of his knowledge, chrome yellow was very extensively used in this country; it was used to produce a harmony of color. By inquiry and observation he had taken pains to ascertain if chrome yellow was injurious, and among the chemists he had consulted was Dr. Liebig, in Europe.

The object of the defense in this trial seemed to be to prove that not only is chromate of lead (which includes "chrome yellow," "chrome green," "orange chrome," and the "American vermilion" of some manufacturers) not poisonous, but that, even if it were so, the small quantities in which it is used would render it harmless. In regard to the first proposition we may refer to a very recent case reported in the *Boston Medical and Surgical Journal* under the head of "Toxicology," where we find the following cases of poisoning by the inhalation of dust containing chrome yellow. The *Journal* says:

"Leopold reports five cases of this form of poisoning, one of which proved fatal. The patients were employed in weaving cloth, colored with chrome yellow (chromate of lead), which was quite loosely applied to the thread, so that a portion of the pigment was easily detached and became diffused throughout the air of the room. The patients were affected with a yellow-coated tongue, yellow sputa, loss of appetite, malaise, in some cases vomiting, pain in the region of the stomach and umbilicus, obstinate constipation, and debility. The fæces were yellow. These symptoms disappeared in a few weeks after the removal of the cause, except in the case of an infant nine weeks old, who died in six or eight days after the beginning of the symptoms, which, however, did not appear until three weeks after exposure to the infected atmosphere. The symptoms in this case were fever, restlessness, shrieking, several yellow fluid stools daily, redness of the skin over the chest and abdomen, parched lips, and, just before death, short respiration.

"After death there were found inflammation and perforation of the stomach, the same appearances which were seen in the two cases previously reported by Dr. Von Linstow, caused by ingesting the chrome yellow. None of the poison could be detected in any of the organs except the lungs, in which 3·6 milligrammes (0·055 grain) were found."

As to the second proposition, the small quantity used: there are but two to three salts of lead that as medicines are adapted for internal administration; and, when it becomes necessary for the physician to employ them in this manner, he uses them cautiously, and in what are called "medicinal doses," for it is well known that continued doses of exceedingly small quantities are the very ones that produce all the dangerous constitutional effects of the lead.

Familiarity with poisons, as with other things, is apt to breed carelessness in handling, if not contempt for their effects; and, because the worker among them testifies to their innocuousness to his own system when self-administered, it by no means follows that the practice is a safe one to recommend to the public. At all events, no such testimony as we have referred to above will serve to remove the prejudice that exists in the minds of parents against allowing their children to be fed on substances that are known to be injurious.

The vegetable kingdom yields such a large number and variety of harmless coloring matters, exactly suited to the requirements of the confectioner, that there is no necessity for resorting to the use of either colored earths or metallic salts, and their employment, therefore, being not only inexcusable, but criminal, should be promptly punished by the arm of the law.

CONGRESS TO BE MADE A PATENT MILL.

If that portion of the new patent bill is passed which provides for the lapsing of a patent in event of the non-payment of an auxiliary fee a few years after its issue, one result will be to convert Congress into more of a patent manufacturing concern than it already is. Every Congressman knows now that not a session passes but that legions of inventors, who have failed or who think they have failed to realize as much as they should during the lifetime of their patents, fill the records with applications for extensions. It was to relieve Congress from this increasing burden that the duration of the patent was lengthened from fourteen to seventeen years, the object being to afford the inventor more time to gather his profits. Under the provisions of the proposed new law, however, it must be obvious that Congress will be besieged by applications to revive patents which have lapsed because poor inventors may not have had the means to pay the additional fees required at the time fixed by law, and for a great variety of other reasons which will be urged. We have already pointed out other objections to this enactment, but the above in its results is by no means one of the least serious, as the consequence will be to engender an immense amount of special legislation, to take up the time and materially augment the work of Congress, and to hinder the progress of measures of public importance.

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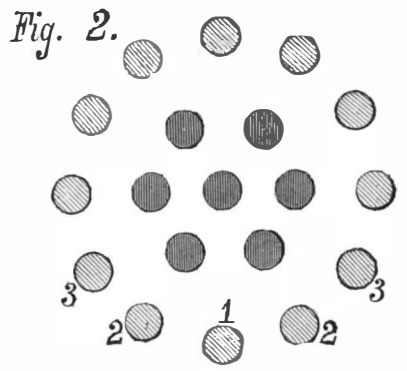
[*Continued from first page.*]

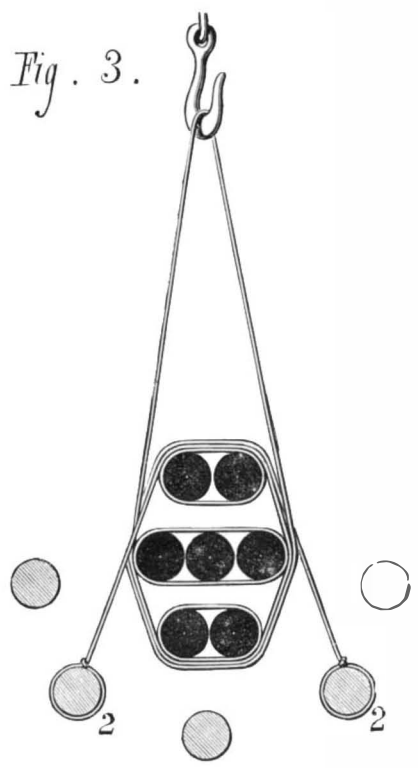
to the corresponding strand, 2, of the envelope on the other side. The hook of a derrick tackle is then put in the bight, and in this way the parts are drawn together. The cross lashings between the strands are then removed. At a few inches inside of the 21 foot 6 inch mark a wooden clamp is applied, and some three feet outward another clamp is attached. Four or five more of these clamps are put on the core between anchorage and pier, for example, and the permanent assembling then begins.

Between the wooden clamps, a massive iron clamp is applied, and its parts are brought together by powerful lever wrenches. This compresses all the strands into an even cylinder, individual wires being prevented from slipping into the joints of the clamp by the downwardly extending horns shown at A, in Fig. 4. There is a special object in thus drawing the core strands so tightly together, namely, to compress them not into a mere assemblage of ropes of circular section, but into a uniform cylinder, of which each strand except the center one will form a segment, as shown in Fig. 4. To assist this formation the strands are beaten into place by heavy wooden mallets, and aided by wedges. The workmen carefully place in proper position such wires as may protrude beyond the smooth cylindrical surface. Now comes the binding, and to do this a buggy is attached to the core, and moved along as the lashings of wire are put in place. The first binding is put on just inside the iron clamp. It consists of No. 14 wire, wound on by an iron ring which encircles the core and has handles to allow of its easy revolution. To this ring the wire is attached, and two men at the handles serve the wire tightly around the core for about 25 turns, the core being previously white-leaded. The end of the wire is secured, the iron clamp shifted ahead, the core is again compressed, another binding is put on, and thus the work progresses, the lashings being about a foot apart.

Three workmen generally occupy the perilous swinging



tray called the "buggy," two engaged as above described, a third handling the wire, and perhaps a fourth man helps in various ways. The dizzy aerial perch of the bridge builders is shown in the engraving on our initial page, and it would seem that they worked on it almost at constant risk of their lives. Yet no accidents by falling have yet occurred. In fact the construction of the great bridge has served to show in a striking manner how men can become habituated to living and working under abnormal conditions, for examples of these are found in the dense atmosphere of compressed air in the caissons while the latter were being sunk, and in the unguarded swinging platforms which traverse the lofty cables. The men seem perfectly at their ease, however, and even tempt fate by walking out on the cables alone, sometimes holding by the slight hand rope provided, or occasionally scorning even this safeguard. The reader may get an idea of the nerve required for this feat by imagining himself walking on a log about ten inches in diameter, placed at an angle of fifteen degrees or so, and at an elevation of a couple of hundred feet. Professional rope walkers, when they essay a performance of the kind, carefully rosin their stocking feet and use a heavily weighted balancing pole; but these workmen walk along unconcernedly with their heavy boots on, and even trot down the inclines, barely touching the hand



rope. One of them laughingly told us that working on the buggy, and getting in and out in the above perilous fashion, had one advantage at least, and that was that tools were safe. Predatory visitors would never find their cupidity sufficiently excited to tempt them from the dizzy foot bridge upon the still more dizzy, narrow, and often greasy core.

When the core is all bound the upper strands, as fast as completed, will be lowered into place, and finally, when all are finished, the core lashings will one by one be taken off, and the whole cable bound together in precisely the same way as above described, larger clamps being of course used. This work, it is expected, will be ended by the coming fall.

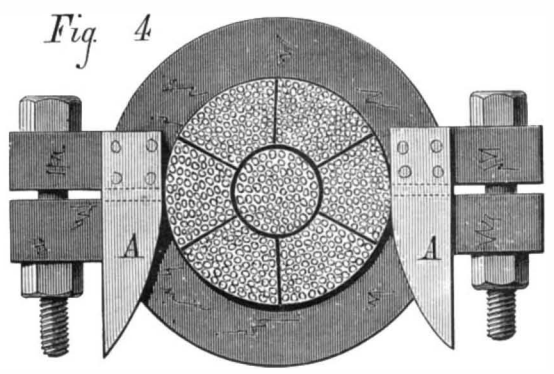
ADVERTISING—A MODE OF MOTION.

When Toddie, in that nursery classic "Helen's Babies," expressed his desire to examine the mechanism of a watch by wanting "to shee the wheels go 'wound," he hit upon a peculiarity of the human race by no means confined to its younger members. Whether it is, as a recent writer on physiological æsthetics has suggested, that anything indicative of life is more agreeable as an object of contemplation than one capable of being associated, however remotely, with thought of death, moving objects being an example of the first, and objects at rest of the second, it is certain that to every one the sight of mechanism in operation is more or less agreeable, and it would seem that the degree of pleasure depends in some measure upon the motion being unusual or unexpected. There is abundant room for speculation on this which we shall not indulge in here, as we mention the topic simply to note that some such mental operation peculiar to most people has recently been turned to account by inventors to enlist attention to advertising signs.

It is positively funny to ride in any horse car in this city, and watch the passengers, sober elderly men and uncontrollable youngsters alike, all gazing fixedly at the moving pasteboard figure of a washerwoman scrubbing clothes, or of a cobbler sewing shoes, or some similar device, inserted in the advertising panels of the cars by enterprising business houses, and kept in motion by the jolting of the vehicle. Why elderly people should persistently stare at these toys is incomprehensible.

We watched a well known and learned judge the other day sit as if fascinated gazing at the figure of a codfish wabbling about in the middle of a fish dealer's advertisement, his newspaper, meanwhile, lying opened, yet unread, on his lap. It is perhaps useless to seek a reason for this. The eye, it is said, delights in circles and curved lines, on account of the gradual use into which all the muscles are called; but we cannot see how it can delight in the irregular vibrations of a pasteboard codfish fastened on a spring. Some people have told us that these moving signs make them actually unhappy—they feel that they must look at them, as if drawn by an irresistible attraction—like Mark Twain's clerical friend who, after once learning the famous horse car jingle beginning "The conductor when he receives a fare," never could get it out of his head, but repeated his sermons in the same rhythm.

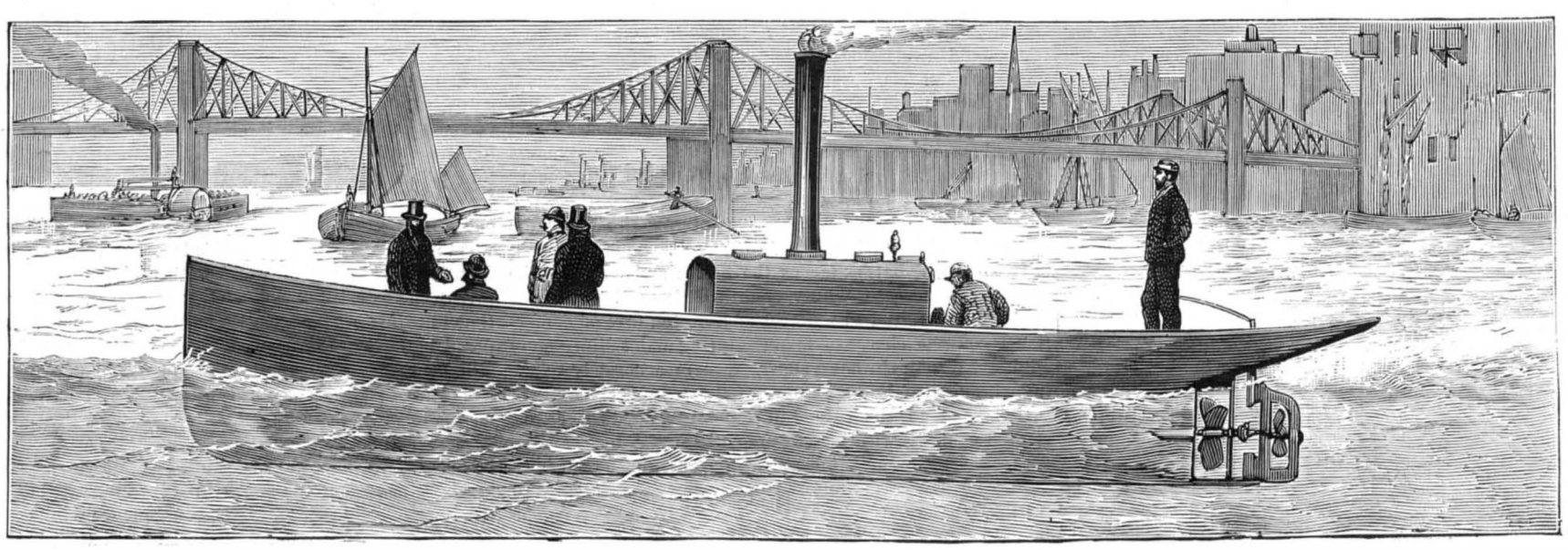
Sensitive people can of course avoid uneasiness of this kind by refusing to patronize cars containing such advertisements, but we fear this mode of escape is short-lived. Another inventor (some nervous individual will assert, actuated by a fiendish and malicious purpose) has contrived a sign which cannot be avoided; it must be looked at. In every one of the large gilt letters this ingenious person makes numerous circular holes. In every hole he suspends a bright tin disk, each being so arranged that all may be vibrated from the moving armature of an electro-magnet, in which the current from a battery fastened behind the sign is alternately broken and established. We do not believe that any one can come within a block of that sign without being morally dragged into looking at it. A crowd, as we write, is standing open-mouthed staring at it. As an individual sign it is an astonishing success, and everybody who sees it will depart with the words "Homes in Florida" persistently flickering on his retina and shaking through his nervous system, dismally suggestive of the tremulous malady incident to Florida swamps. But then, supposing this sign came into general use; suppose both sides of Broadway



united in one grand twinkle and flicker—the idea is too horrible. Some of our readers may have vivid imaginations combined with sensitive nerves, so we forbear.

A RUDDER AND SCREW COMBINED.

The object of this steering apparatus is to make a vessel to turn more quickly than it can be made to do by any other means, an achievement which is manifestly desirable in view of the many collisions which occur from deficiency of steering power. It is claimed to be applicable to vessels of all sizes, and can be worked either by steam or other motive power, and in conjunction with, or entirely separate from, the ordinary screw propeller, and it has the additional advantage of increasing the speed of the vessel when going straight ahead. A glance at the engraving, for which we are indebted to the London *Graphic*, will show that a screw is fitted in the rudder, and this screw is connected with the revolving shaft by means of a universal joint, so that, in whatever position the rudder may be placed, the screw continues to turn, and the course of the vessel is altered with ease and speed.



THE KUNSTADTER RUDDER SCREW.

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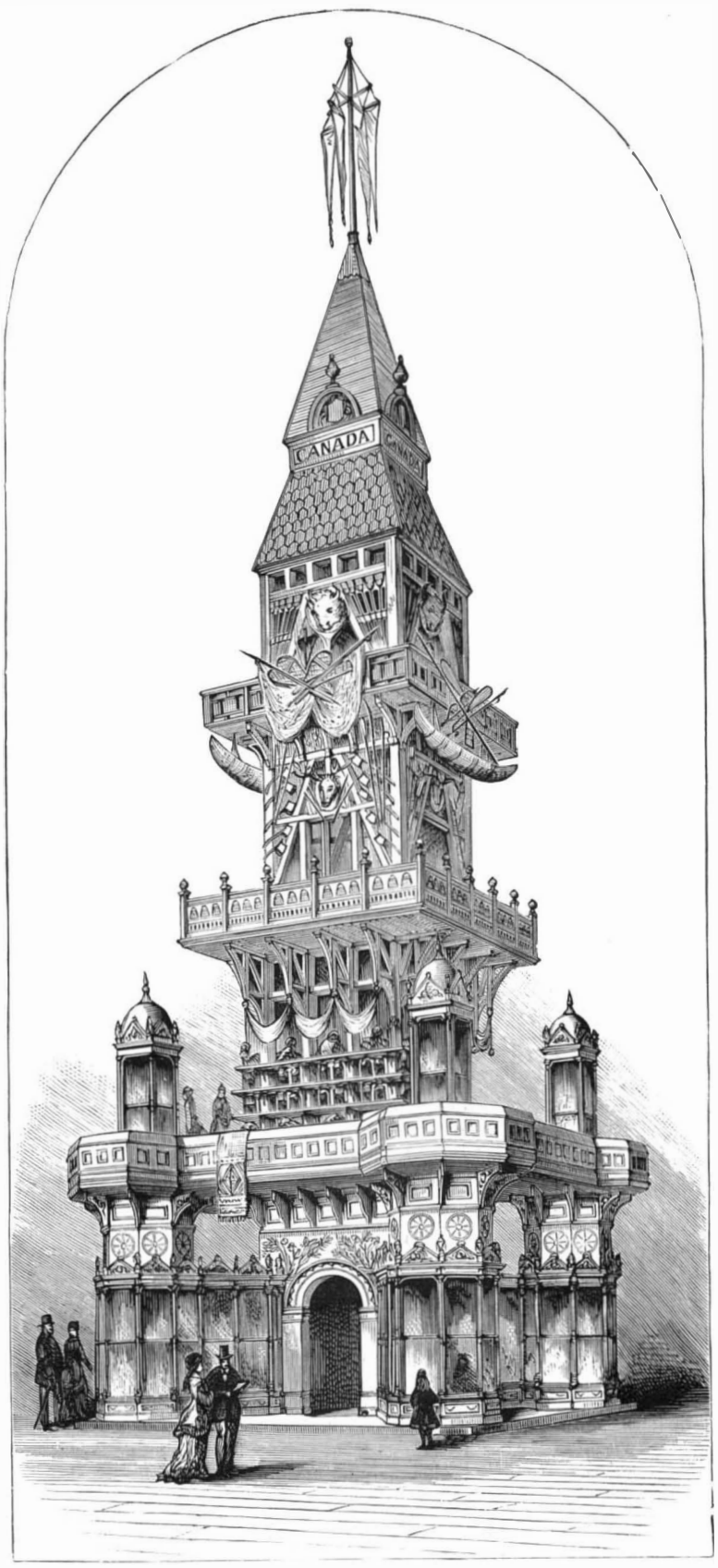
M. CLAUDE BERNARD.

M. Claude Bernard, whose portrait we present herewith, is justly entitled to the credit of having raised physiology to the dignity of a separate science. He it was who proved that the infinite variety of functional phenomena, with relation to the endless diversity of organic forms, is based on fundamental truths, which collect on common ground all living things, without distinction of classes or orders, whether vegetable or animal. The liver, he showed, made sugar the same as does the fruit; beer yeast is subject, the same as man, to anæsthesia when submitted to etherized vapor. For the physiology of animal mechanism he showed that anatomical deductions are insufficient and often erroneous; and that experiment only can conduct to certainty. The rules of such experimenting, he demonstrated, are the same in the sciences of life as in those relating to inanimate bodies, and that there are not "two contradictory natures, giving place to two orders of opposite sciences." He pointed out that the experimental physiologist not only analyzes and demonstrates, but dominates and directs, and that he may be a "conqueror of nature" as well as the chemist or the physicist. M. Bernard died in February last at the age of 65 years.

M. CLAUDE BERNARD.

THE CANADIAN TROPHY AT THE PARIS EXHIBITION.

This beautiful structure is erected under the northwest dome of the Exhibition Building in Paris. On entering the principal doorway from the left bank of the Seine, one finds one's self in a magnificent transept, over 800 feet long and about 80 feet wide, divided in the center by a tower 80 feet square, and at each end are towers covered by domes 111 feet square. The ceilings and walls of this immense transept and its domes are profusely and gorgeously decorated with mouldings, gilding, and carvings. It is probably one of the largest and richest galleries ever erected. Here the trophy is being put together. It is in the form of a tower, with a high pitched roof. The base occupies a space 30 feet square, from the center of which rises the main framework to a height of about 100 feet. This height is divided into four stages. From the angles of the framework, on the ground level, handsome glass cases radiate, designed for the exhibition of manufactured goods. The remaining three stages have projecting galleries, supported by ornamental brackets. These galleries will contain the productions of the mines and forests. Access to them is obtained by means of a circular wooden staircase of novel construction in the center of the trophy. The roof is divided in the center of its height by a band, on which the word "Canada" is cut out in fretwork. The roof is covered in part with slates and in part with shingles and bark. The exhibits will be so arranged that the framing timbers, which are of red pine, will be left exposed to view. The woodwork will be finished in oil, to bring out the natural grain of the wood, so that visitors may examine specimens of the different timber grown in Canada. We are indebted to the London *Illustrated News* for our engraving.



THE CANADIAN TROPHY AT THE PARIS EXHIBITION.

Dry Plate Developer.

When a dry plate is coated with a preservative principally or entirely consisting of gallic acid, it can be rapidly developed by the following solution: Distilled water, 100 c. c.; crystallized silver nitrate, 4 grammes; acetic acid, 4 grammes. Place the plate, film downwards, in a trough of rain water, so as to moisten the whole of the film without unequally removing the preservative, then pour all over it the above solution; the picture will quickly appear, and will generally be completely developed. It must be carefully watched, and washed as soon as it seems to be sufficiently intense.

All photographers who are in the habit of developing dry plates have observed that when too much silver nitrate has been added to the developer, the intense blacks of the negatives were riddled with small holes. The formula which I have given above does not produce this result, even though the proportion of nitrate be much larger; the reason of this apparent paradox I am not in a position to explain.

I have only tried this developer with stereoscopic positives on albumen or albumenized collodion, and I am bound to add that I have obtained very unequal results. I therefore introduce it to public notice with some hesitation, though I believe that by washing off the preservative and by modifying the proportion of the ingredients, a very rapid and energetic development will be obtained.—*M. Queval, in Bulletin Belge.*

Swiss Double Postal Cards.

We are indebted to M. Adolphe Eggis, of Fribourg, Switzerland, for a specimen of the double postal cards which have been in use in that country for more than a year. The material is paper of the same quality, but a little lighter than that of the postal cards of the United States. The card is folded into two leaves, which may be separated at the crease, each of which is 5½ inches long by 3⅝ inches wide—a size considerably larger and more serviceable than that of our postal cards. The printing on both cards is the same, and each has a five centime stamp, that on the return half of the card of course remaining uncanceled until remailed.

Bursting of Hose Pipe—A Remedy Wanted.

The bursting of hose pipe at fires is about as common an occurrence as a fire itself, and even more so, for not unfrequently it occurs several times at one fire, thereby causing a much greater destruction of property than would otherwise have happened. This was especially the case at the late fires in New York and Philadelphia, where the loss of hundreds of thousands of dollars' worth of property was wholly attributable to the bursting of the hose. And the great loss from that source has led the people of these cities, through their representatives, to call for a most thorough and rigid investigation into the quality of hose used, expecting thus to find a remedy. Undoubtedly some progress may be made in that direction by using a very superior article of hose, but as it will be impossible to ascertain what pressure it required to burst them, very little information of a satisfactory character will be attained.

This is a subject that has long engaged the attention of both firemen and mechanics, and various remedies have been suggested and various devices used, many of which were probably in the right direction. As yet, however, they have failed to accomplish the desired result. Among the most important of these improvements has been the introduction of a relief valve at the engine pump, to relieve the working pressure when it should exceed that required. This improvement has undoubtedly saved thousands of feet of hose and many thousands of dollars' worth of property. But still the bursting of hose goes on, and still the invisible foe remains, and is no respecter of persons or of hose. Whenever or wherever his forces are concentrated, a rent is made, the pipe is burst, the fires burn on unchecked, until another pipe is laid to take its place, when, far too soon, it shares, perhaps, no better fate.

Thus far, then, the problem remains practically unsolved, even by those who heed it most and understand it best. Several years ago the writer was called upon to aid in the perfection of a relief valve for fire engines, to prevent the bursting of hose pipe, when he discovered that it was only "locking the stable door after the horse had been stolen," for before the valve would be called upon to act, the mischief would be done—the pipe would be burst. It was not the static pressure consequent upon the working of the pump that burst the hose, for it will require usually more than double the pressure necessarily used in the pipes to cause them to burst. From these facts we are led to the conclusion that the static pressure is not the force that bursts the hose. Consequently, as that is not the real cause, a relief valve at the pump cannot be a certain remedy, though it may be useful and important as a relief from an over pressure, and to that extent valuable. If, then, as shown, it is not the static pressure that bursts the pipes or hose, what, then, is it, for the pipes are burst? It is the accumulated energy of the rapidly moving water within the pipe, backed by the static working pressure of the engine pump, and unless relief can be had at or near the point where this force is concentrated, the pipes, although abundantly strong enough for practical use, will not stand such concentrated force, and must necessarily yield to it. This force, under certain circumstances, becomes immense, and as water is a non-elastic substance, its whole energy is thrown upon some particular point of the pipe. The real wonder is not that the pipes frequently yield to its immense power, but that they stand it so well.

To illustrate more fully this power, let us take, for example, a pump working under a pressure of one hundred pounds per square inch of area, and forcing water through a pipe one hundred feet in length, with a moving velocity in the pipe of, say, thirty feet per second. The accumulated power of this water equals its weight multiplied by its velocity per second, and backed up by the static pressure of the pump. As the pump pressure equals one hundred pounds per square inch, the accumulated force of a body of water one hundred feet long, one inch square, equals 44·4 lbs. × 30 = 1,332 lbs. + 100 lbs. of pump pressure, = 1,432 lbs., the force that would be concentrated on the pipe. Should the pipe be straight and the flow of water instantly impeded, under such circumstances what pipe would stand the pressure? But as this, even, may not be the limit of this power, it must be apparent to every one familiar with this subject that pipes ever so well made must continue to burst unless relief can be had at or near the point where the flow of water is stopped, for the whole momentum of the water will be spent on the pipe before a relief valve at the engine would come into action. But a relief valve in each hose coupling would afford a relief once in every twenty-five feet, at least, and with relief valves thus arranged the bursting of pipe of reasonable strength would be nearly if not en-

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tirely prevented. This would afford such a practical solution of the whole question as would save and make serviceable large quantities of pipe that are now useless, and would add to the efficiency of fire departments and materially lessen the cost of their operation.—*T. T. Prosser, in Western Manufacturer.*

Roll while the Ingot is Hot.

Mr. Bessemer lately said that he remembered one of the great failures he made in his earlier experiments arose from his not attending to the above. He took advice strongly given to him by Sheffield manufacturers, who were used to their own mode of producing steel, and he learnt from them, as a fact, that a steel ingot must never have the hammer upon it while it was hot, and that it must never go to the rolls while it was hot, but that it must be left to cool, and the next day it was to be reheated. When one heard those things from practical men who had really made a mark in the world by their products, as the Sheffield manufacturers evidently had done in the olden time, one was apt to be led by it without going very much into reasoning. He thought it was necessary that cooling should take place, and that reheating should follow it. At one of his earlier experiments, made at one of the largest works in that part of the country (when their material was of an inferior kind to that, he was happy to say, all those around him were able to make today), they let one of their ingots get cool. It was rather a large one, and larger than any they had practiced upon at the time. It was reheated in one of the ordinary reheating furnaces—they were all waiting for the result, and the fire was teased most tremendously—they managed to get it gloriously hot on the outside, in fact it almost melted, while in the inside it was almost black. They attempted to put it through the cogging rolls in that condition. The result was a most singular one. The large mass went through the rolls, and about 1 inch to 1½ inch in thickness was stripped off from it, and an apparently black mass shot through the rolls, to the horror and consternation of all of them. After seeing that, he came to the conclusion that to let the ingot get cold was a mistake, if they were not obliged to do so from some circumstance or other. He came to the conclusion that he himself had worked out that an ingot, when cast, was hottest in the middle, and coldest outside, and the small interval that elapsed between the heating and rerolling would allow for cooling the inside and equalize it; but in all cases there would be a tendency for it to be softer inside than outside, instead of, as in the other mode of working, soft on the outside and hard in the center; and he was very glad to find that the conviction of the fact had prevailed and been attended to, and they were able now either to cog or to hammer down ingots in their original heated state from the casting. He thought that was an important addition which he was very glad to find Mr. Holland had so successfully carried out.

The Telephone and the Phonograph in Practical Medicine.

In a communication to the *Lancet*, a writer states his convictions that the telephone, combined with the phonograph, will become a necessity in clinical medicine, inasmuch as we have, in the phonograph, a means not only of registering sounds, but of reproducing them. "However much the telephone may be perfected for clinical purposes, it must always fail in transmitting sounds of the same quality as those received, consequently this defect will necessitate a special education of the ear to interpret the modified sounds. But with the phonograph sound vibrations can be made visible to the eye, registered on paper like pulse-tracing, and kept for future study and reference."

Dr. Steiu has recently invented a method of photographing the beats of the pulse. It consists in photographing a beam of light which has been passed through a perforated vibrating disk. The perforated disk is attached to the artery like the sphygmograph. A strong light passing through the hole in the disk is made to reach a sensitive plate, on which the movements of the disk are recorded in the form of a wavy line. This invention might be made available for registering the sound vibrations of the telephone; for, by attaching a perforated disk at right angles to the receiving telephone drum, the vibrations of the latter could be recorded.

Medical Uses of the Microscope.

Dr. Cutter, of Boston, lately gave a list of Dr. J. H. Salisbury's scientific papers published since 1862 in illustration of original studies of the morbid alterations in blood.

Epithelial cells from the mouth and some from the liver were shown. These microphotographs were those of J. J. Woodward, Surgeon U. S. A., the father of modern microphotography. The nucleus and the bioplasm were pointed out. Attention was called to the fact that the form elements gave no idea of the work performed by the cells. The differentiation lies in the vital endowments of the bioplasm.

The cell that secretes bile or the tears has the same form elements as one that secretes milk. If separated they could not be distinguished apart. A dead bioplast could not secrete, though it may have been much longer in dying than the systemic body. Brunonian movements of the mucous corpuscles were alluded to as protoplasmic. These form good tests for objectives.

Microphotographs of vaccine virus were shown. This gives an excellent idea of Beale's view of a taint. The field is full of granules—germs—which are, he says, degraded bioplasm. A remarkable specimen of a protoplasmic plant that grew in the substance of a seaweed was exhibited. There is every probability that never before has it come under the eyes of man, as Professor Reusch, who prepared it, says it is entirely new. It has many lobes. Notice the buds shooting out. The weird, bizarre outlines remind one of the amœboid forms of the white blood corpuscle. It serves to illustrate vegetable bioplasm and also parasitism. It is probably innocuous.

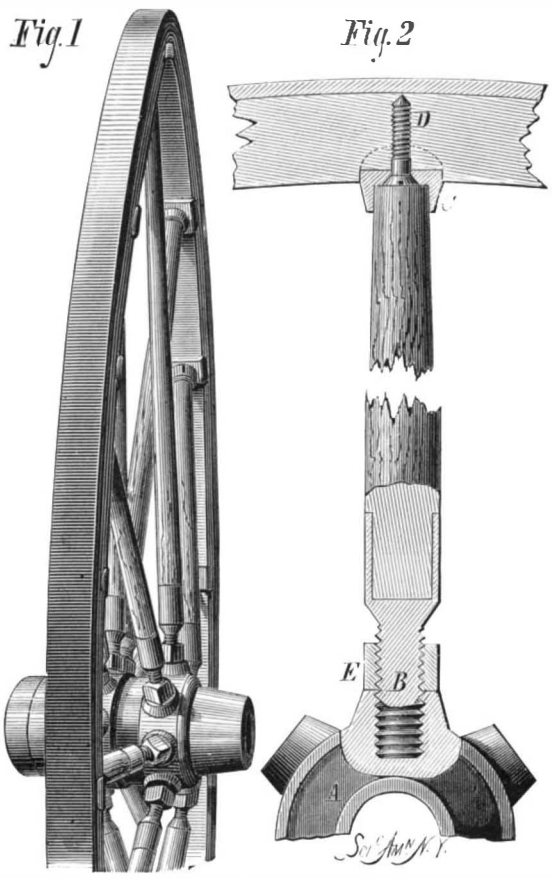
The healthy white corpuscle was clearly seen, and the importance of using microscopes that would show the white corpuscles as white was insisted on.

The white blood corpuscles of consumption and the nameless disease were displayed by means of microphotographs taken with the one seventy-fifth and one fiftieth inch objectives, and attention was particularly called to the physical changes going on inside.

Another illustration was a picture of consumptive cells, taken after three months of remedial treatment in which dietetics bore an important part. The white corpuscles were nearly all reduced to their normal size. The spaces were lessened in number, and the physical relations of the red corpuscles had improved. This was not an isolated evidence. With this reduction in size came a notable restoration to what was termed a healthy condition.

DETACHABLE SPOKE VEHICLE WHEEL.

We illustrate herewith a new vehicle wheel, the principal feature in which is that the spokes can be easily removed and new ones inserted in their stead without disturbing the tire or felly. They are placed in two rows upon the hub, from two to four inches apart, and each spoke is provided with a metal ferrule terminating in a screw. The felly has a metal socket to receive the outer end of the spokes.



DEADERICK'S IMPROVED VEHICLE WHEEL.

The construction will be understood from the sectional view, Fig. 2. It will be observed that there is a metal hub band, A, having suitable elevations, and that the spokes in one row, Fig. 1, stand opposite the spaces between those in the other. B is the spoke ferrule, terminating in a threaded end. C is the felly socket, fastened to the felly by the screw, D. This socket is let into the felly for a short distance, and braces it by semicircular ears. In order to remove a spoke the nut, E, is loosened and screwed up. The socket, C, is then grasped with a wrench, and the spoke, or rather the threaded ferrule end, B, is screwed downward into the hub until the outer end of the spoke is clear of the felly socket, C. It only remains to spring this end clear of the felly, and unscrew the ferrule end, B, from the hub. The spoke is inserted by reversing this process.

When, however, as in a heavy vehicle, the spoke is too stiff to be sprung, it must be of such a length as to reach exactly from hub to felly, and the felly socket must stand further out from the latter and must be detachably secured by bolts. In removing a spoke this socket is first unbolted and slid to one side before the spoke is unscrewed from the hub.

The hub bands, spoke, and felly sockets may be made of malleable cast iron, soft cast steel, or drop forged iron. The weight of the castings varies from two to four pounds per wheel. The felly socket may be a simple plate with ears, and a circular hole through which the tenoned end of the spoke passes into a shallow recess in the felly. No screw is needed to keep it in position, as it is held by the pressure of the spoke. Should the tire become loose, the inventor states that it may easily be tightened by screwing out the spokes against the felly. A loose spoke may also be tightened in similar manner; and by manipulating the spokes the wheel may be straightened, should it get out of plumb. In case the showing of the threads on the spoke ferrule piece is objectionable they may be screwed down close into the hub, and the wheel may be put together, or the felly and tire put on, as other wheels. In order to remove a spoke it will in such case be necessary first to spring out the felly with a lever until the end of the spoke is clear of the socket, and then holding the spoke to one side unscrew it from the hub.

For further particulars address the inventor, Dr. C. Deaderick, Knoxville, Tenn.

Microscopy.

The Myxomycetes of the United States.—Dr. M. C. Cooke, the eminent English mycologist, has from time to time been making revisions of the various orders, genera, and species of American fungi, from material furnished by his correspondents in this country, and publishing the results of his labors in the *Proceedings* of our various scientific societies, so that they shall be readily accessible to American students, the number of which, in this interesting field of research, is largely on the increase. A contribution of this character, with the above title, has recently been published in the *Annals* of the Lyceum of Natural History of New York.

The group which has, in this case, undergone revision consists of fungi that are mostly minute in size, and characterized in their early stage by their gelatinous nature. They have an especial interest for the student of biology, inasmuch as the celebrated Dr. De Bary, some years ago, excluded them from the vegetable kingdom altogether, and made them companions of those low forms of animal life known as *Amœbæ*, etc. The gelatinous material of which they are composed in their first stages bears considerable resemblance to sarcode, and did they never change from this there would, perhaps, be little doubt of their animal nature; but as they mature they lose their mucilaginous texture and become a dusty mass of spores, intermixed with threads, and the whole surrounded by a delicate covering, called the *peridium*. In a systematic arrangement they are placed in the neighborhood of the "puff-balls."

In the present communication (which is necessarily of a technical nature, but of great utility) the author has taken the opportunity of thoroughly revising the North American species of *Myxomycetes*, on the basis of the classification proposed by Dr. Rostafinski, in a monograph published by him in 1875. And it may be stated here, as a remarkable example of the devotion of a naturalist to his favorite pursuit, that his monograph having been written in the but little read Polish language, Dr. Cooke began the study of the latter and mastered it, in order to avail himself of Rostafinski's views. For half a century the species of this order of fungi have been classified according to external characters alone, or such only as could be discerned by the aid of the pocket lens. The advance of microscopy left behind such an incomplete system for years, until Dr. Rostafinski published the outlines of a classification based on new principles. As the old method was based wholly on external features, so the new one has nearly all its essential characteristics relating to internal structures. In using the new system, it is first necessary to determine the color of the spores, then the presence or absence of threads (*capillitium*), and finally the character of the latter, and when present, all its details. The dimensions of the spores are also taken into consideration, but are not regarded as of so much importance as the foregoing features.

The threads which are intermixed with the spores in many of these little fungi exhibit, when examined under the microscope, a spiral arrangement which has given rise to as much controversy as the markings of some of the diatoms. The dispute has been whether the spiral markings were external or internal, whether caused by the twisting of the thread or by the presence of an external or internal fiber.

To return to Dr. Cooke's paper: One who is somewhat familiar with the subject will, on turning to the genera and species, as they are here classified, be struck with the newly proposed generic names and the wholesale conglomeration of species that have hitherto been supposed to have a distinct individuality. But, as an offset to this, we have in some cases what have been supposed to be forms of the same thing, separated and elevated to the rank of distinct species. As the system of Rostafinski is the one that will probably be adopted, the synopsis here offered by Dr. Cooke will prove of incalculable value to American mycologists.

The Stings of Hymenopterous Insects.—At the last meeting of the New York Microscopical Society the President, Mr. Hyatt, read an interesting paper on this subject, made the more valuable from the fact that it embodied the results of his careful studies, extending over a period of eight years. It would be useless to attempt a synopsis of his remarks without the aid of the beautifully executed microscopic drawings which accompanied the paper, and which added so much to its interest and value. The memoir, illustrated with copies of these drawings, made under the personal supervision of the author in order to insure their accuracy, is soon to be published by the society. A point in the structure of the bee's sting, which the author apparently regarded as new, has been mentioned in print several times; and, in fact, has been illustrated in one of the back volumes of *Science Gossip*. We refer to the channels that lead from the central cavity of the sting to the bases of the barbs. Mr. Hyatt stated that, as far as he had been able to discover, no really correct representation of the sting of a bee had ever been published. If this be so the publication of this paper will not only reflect great

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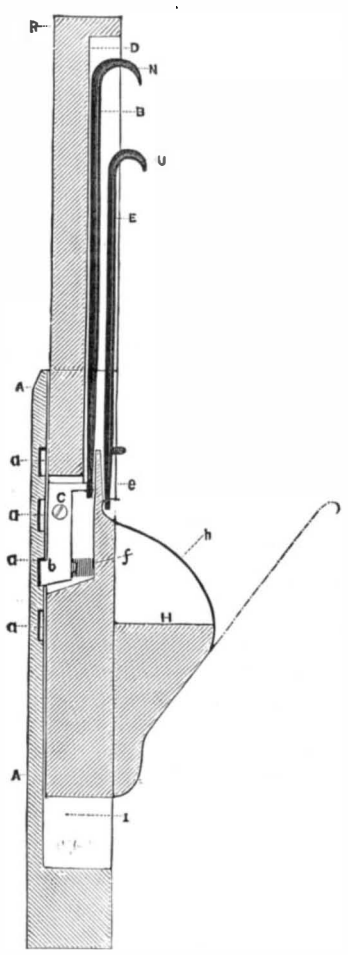
credit on the author, but also on the new, but energetic and accomplished, society over which he presides.

Plant Crystals.—At a recent meeting of the East Kent (Eng.) Natural History Society, Professor Gulliver, F.R.S., exhibited numerous drawings of *Raphides*, and other microscopic plant crystals, accompanied by explanatory remarks. From the latter we glean the curious and novel information that some trees and other plants, from stem to branches and leaves, are invested with a most delicate network, or tessellated pavement like mosaic work, of cells all studded with *sphæraphides*, so that each cell is set and adorned with a gem of one of these beautiful crystals. The "Angelica tree" (*Aralia spinosa*) was said to form an example, beneath its bark or epidermis, of this external skeleton of crystalline tissue. And an internal crystalline skeleton was shown in other plants, including some *Leguminosæ*, as may be well seen in the common white clover, the crystals being arraged in chains along the vascular bundles. Mr. Gulliver remarked that, boiling a portion of the plant before its examination, in the solution of caustic potash which is kept by druggists, exposes the crystals very clearly. He added that he had learned that the long crystal prisms of the iris tribe are admirably suited for experiments on polarization of light; and he believed that the whole subject of plant crystals belongs to the vast domain of the cell biography of plants, which has hitherto been too sadly neglected, but which must be diligently cultivated before we can hope for the most complete system of botanical classification and knowledge of the laws which govern the vegetable kingdom.

SHUTE'S ADJUSTABLE SAFETY STILT.

The accompanying engraving is a sectional view of a new stilt, which is so constructed as to be capable of being raised



IMPROVED STILT.

to any desired distance from the ground, and from which the wearer can release himself in case of falling by freeing a spring hoop which passes over the foot. The device is made in two parts, one having guides and sliding in a channel, I, in the other portion, A. There are recesses or indents, *a*, in the bottom of the channel, I, to any desired number. R is the handle, and H the foot piece made on its lower end. The handle is provided with a catch, *b*, pivoted in a recess at *c*, with a spring, *f*, placed behind to throw it outward; and the lower end of rod, B, sliding in a groove, D, made in the handle, is connected to the rear side of the catch at its upper end. When the rod, B, is pulled upward by the hook, N, the lower protruding end of the catch *b* is drawn in, when the socket, A, being moved a little up or down, and the rod released, the catch, *b*, will snap into any of the recesses, *a*, as may be desired to make the stilt longer or shorter, or the foot piece, H, nearer to or farther from the ground. In moving it up or down the handle, it is kept in proper position in the channel, I, by cleats fastened to the face of the socket, A. In the same groove, D, is a rod, E, held down by a staple, and spring hoop, *h*, is secured to the other side of the foot piece, H, which is sufficiently long to be bent inward over the foot piece. Its upper end is secured inside the latch rod, *e*. The object of this spring hoop, *h*, is to assist in securing the foot to the foot piece, H, and it may be released and the spring caused to fly outward instantly (as shown by dotted lines in the engraving), if there is any danger of falling, by pulling up the latch rod, E, by the hook, U.

For further particulars as to rights or for descriptive circulars, address the inventor, Mr. Charles S. Shute, Springfield, Mass.

TOO MANY NAMES.

Professor Hayden, at the late meeting of the Academy of Sciences, called attention to the inconveniences arising from the duplication and even multiplication of the same name, as applied to towns or geographical localities in this country. There was some discussion as to the best means of checking this source of annoyance to geographers and the Post Office people, and Professor Gilbert thought that the Land Office might in some way interfere to check the repetition in new towns of the West. But this would not help matters for places that are already named. For instance, the current *Post Office Guide* gives twenty-eight Washingtons, and fifteen places have Washington as a prefix, with the further designation of Corners, Court House, and in one case the euphonious Gulch. There are three New Yorks, seven Philadelphias, a dozen Bostons, sixteen Albanies, and thirteen Providences. The ubiquitous Smith has modestly given his cognomen pure and simple to but one town, but he lavishes it in connection with various endings. Smith has eight "Mills," three "Landings," twenty-three "Villes," besides innumerable "Fords," "Gaps," "Flats," and "Ferries." A few moments' examination of any gazetteer will show that this practice of multiplying names is degenerating into a nuisance, and, in directing notice to the fact that in fixing new localities through the surveys of the Western Territories the same multiplication is constantly occurring, Professor Hayden utters timely warning.

It is not so easy, however, to devise a remedy. Certainly any man who makes a clearing and builds a log cabin has the inalienable right to call his habitation what he likes; and if somebody else builds alongside of him, that somebody may designate his hut as he pleases. This is the English style, where everybody that has a country seat, if it is on only a twenty-five foot lot, calls it this or that Hall, or some other fine sounding name, and the Post Office people eventually learn and remember it. But if settler No. 2 agrees with settler No. 1 that both cabins shall be known as Paris, they are not infringing any law of the land; neither are settlers Nos. 3 and 4, who squat five miles off and agree to call their hovels Paris also. There is nothing in the Constitution about this, and we fail to see how the military or civil power could reasonably be requested to interfere and pull down one or the other Paris in the event of the owners thereof declining, like Romeo, to throw off the name which is no part of them. In fact we do not see how any reform could be made among the twenty-eight Washingtons, for example. Shall we establish a court and try the cause on the interference principle, making each town prove priority of application of name? The result would be twenty-seven nameless towns, and twenty-seven populations eagerly demanding information as to where they lived anyhow. Or shall we devise a system of geographical copyright or patent, so that any town which appropriates a "new and useful" name may have exclusive right to the same, after an official examination? The opportunity of calling into existence a new host of officials should render this scheme especially luring to the congressional mind; and the litigations incident to disputes between similarly named towns would be useful to the legal profession. The last resort is, when we take the next census, to require county authorities, in which there are similarly entitled localities, to alter the names. The State authorities might then carry through a like revisal in cases where similar names occurred in different counties, and the United States Interior Department adjust matters where similar names occurred in different States. This would be a troublesome and probably costly proceeding, and the result now would be scarcely worth the labor; but, on the other hand, if similar names are to go on multiplying throughout the West as they have in the East, the line will have to be drawn somewhere, if only out of regard to the rising generation, who must study the geography of the country.

Photos in Colors.

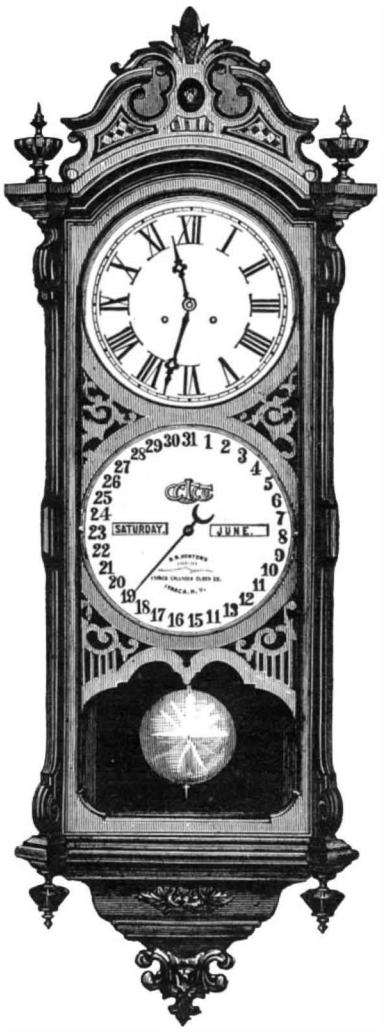
The principle of the production of the Albert process for the production of colored photographic prints is that three negatives are made after the colored original, one in which the blue had no effect upon the plate, but all the other colors. This negative is used for the production of the Lichtdruck plate for blue color. In the second negative all colors take effect except yellow; in the third, all colors except red. The second negative, therefore, forms the Lichtdruck plate for the yellow; the third, that for the red color. All three plates are printed upon the same paper, and furnish the complete picture.

Gold Lace.

Gold lace is not gold lace. It does not deserve this title, for the gold is applied as a surface to silver. It is not even silver lace, for the silver is applied to a foundation of silk. The silken threads for making this material are wound round with gold wire, so thickly as to conceal the silk; and the making of this gold wire is one of the most singular mechanical operations imaginable. In the first place, the refiner prepares a solid rod of silver about an inch in thickness; he heats this rod, applies upon the surface a sheet of gold leaf, burnishes this down, applies another coating, burnishes this down, and so on, until the gold is about one hundredth part the thickness of the silver. Then the rod is subjected to a train of processes which brings it down to the state of fine wire; it is passed through holes in a steel plate lessening step by step in diameter. The gold never deserts the silver, but adheres closely to it, and shares all its mutations; it is one hundredth part the thickness of the silver at the beginning, and it maintains the same ratio to the end. As to the thinness to which the gold coated rod of silver can be brought, the limit depends on the delicacy of human skill; but the most remarkable example ever known was brought forward by Dr. Wollaston. This was an example of solid gold wire without any silver. He procured a small rod of silver, bored a hole through it from end to end, and inserted in this hole the smallest gold wire he could procure; he subjected the silver to the usual wire-drawing process, until he had brought it to the finest attainable state—being, in fact, a silver wire as fine as a hair, with a gold wire in its center. To isolate this gold wire he subjected it to warm nitrous acid, by which the silver was dissolved, leaving a gold wire one thirty thousandth of an inch in thickness—perhaps the thinnest round wire that the hand of man has yet produced. But the wire, though beyond all comparison finer than any employed in manufactories, does not approach in thinness the film of gold on the surface of silver and gold lace. It has been calculated that the gold on the very finest silver wire for gold lace is not more than one third of one millionth of an inch in thickness, that is, not above one tenth thickness of ordinary gold leaf.—*Coventry Standard.*

IMPROVED CALENDAR CLOCK.

Our engraving represents an ingenious clock, wherewith is combined a calendar that perpetually indicates the hour of the day, the day of the week, the day of the month, and the month of the year. This calendar apparatus, being purely a gravity machine, not operated by any spring or levers, and requiring but a very slight weight to be raised



THE ITHACA CALENDAR CLOCK.

and dropped once in twenty-four hours, does not entail, we are informed, any perceptible labor upon the clock movement, as the necessary work is evenly divided through the whole twenty-four hours. The most delicate watch movement made, it is claimed, has ample power to operate the largest calendar. The apparatus within itself makes all the leap year changes, and if properly started (there being carefully printed directions with each clock), kept wound up, and running perpetually, will show upon its face accurately all the information above noted. Each calendar, before leaving the manufactory, is tested on a specially invented machine for that purpose, whereby all changes through eight years of time are repeated, so as to render a perfect record certain when the clocks go into service. The illustration represents a bank calendar clock with 12-inch dials, of the type often used by jewelers for regulators. For further particulars see advertisement of the Ithaca Calendar Clock Company in our advertising columns.

William Orton.

We note with much regret the death of Mr. William Orton, President of the Western Union Telegraph Company. Mr. Orton was a self-made man, beginning life as a printer's boy, and gradually rising through various positions in mercantile and political life, until in the office he last held he found ample scope for his great enterprise and rare executive ability. He possessed a ready appreciation of inventors' work, and was quick to advocate the adoption and use of new and improved devices calculated to add to the extension and efficiency of the telegraph system or the convenience of the public. He died at the age of fifty-two years.

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THE BUCKEYE AUTOMATIC STEAM ENGINE.

The accompanying engravings represent the latest improvements in a horizontal steam engine, built by the Buckeye Engine Company, of Salem, Ohio, which is claimed to possess many new and sterling features both in design and construction. Fig. 1 shows a longitudinal elevation on the valve chest side. Fig. 2, a horizontal section of cylinder and valves. Fig. 3, the governor. Fig. 4, we are informed, is an exact facsimile of a pair of cards from a Buckeye engine of 250 H. P., in Lafayette, Ind., showing its performance.

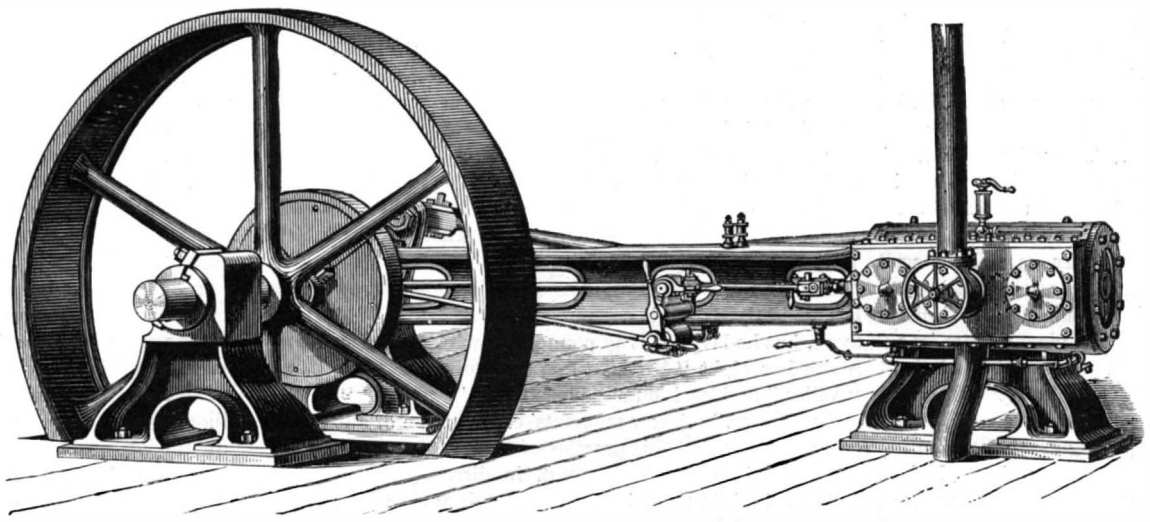


Fig. 1.—THE BUCKEYE AUTOMATIC STEAM ENGINE.

By reference to Fig. 1, it will be seen that the general design is symmetrical and well conceived. Both cylinder heads are sunk from four to six inches into the cylinder, and being cast hollow are filled with non-conducting material, as is also the space under the cast iron jacket, the entire surface being thus protected from external condensation. The piston is of the well known Babbitt-Harris type, consisting of sectional rings set out by German silver springs. The crosshead is divided vertically and lengthwise into halves. Into this the steel piston rod is screwed, and the halves are clamped firmly upon the thread and upon the taper and shoulder of the pin by three strong bolts. There is claimed to be no possibility of the rod backing out; the use of jam nuts or keys is avoided, and instead of compensating for the wear of the connecting rod brasses by putting in liners, the bolts are slacked, the rod is screwed in sufficiently, and the parts are clamped fast again. The guides are flat surfaces with a central V groove, and both the top and bottom guides are oiled from graduating cups with glass bowls, as seen in Fig. 1, thus avoiding the use of the squirt can. The shafts are hammered, and have exceptionally large and long bearings, the proportion invariably being, length of bearing the diameter of cylinder, and diameter of shaft one half the diameter of cylinder. The crank head, fly wheel, and connecting rod are carefully balanced.

By reference to Fig. 2, the main valve is seen to be a hollow box, taking steam on the inside, balanced by the exclusion of steam pressure from the back, and driven in the usual way by an eccentric fast on the shaft. Steam is admitted from the inside of the valve to the cylinder and exhausted into the chest, the reverse of the ordinary operation. For this the following advantages are claimed: The valve seat is brought close down to the bore of the cylinder, and the engine being two ported, and these ports short and direct, the clearance volume is reduced to less than two per cent of the volume of the cylinder; the chances of leakage are reduced one half; freedom from back pressure is attained; surface condensation is avoided; and the live steam is enveloped in hot exhaust instead of being exposed to cold air. There being no pressure in the chest, no packing is required in the joints, and the valves and piston can be readily inspected for leakage by running the engine with the chest lid removed.

The valves are fitted up under steam at 80 lbs.; insuring freedom from leakage or cutting from distortion caused by expansion under heat or pressure. The cut-off mechanism consists of a light cut-off valve, working on the inner face of the main valve, the stem passing out through the hollow steel stem of the main valve, and being driven from a loose eccentric on the shaft with a special motion derived from the compound rock shaft. This loose eccentric is controlled by the governor, Fig. 3, which is a shell fast upon the shaft and revolving with it. In this shell are pivoted two weighted levers, the outer ends of which are linked to the flange on the elongated sleeve of the loose eccentric. The centrifugal force developed in the weights throws them outward, and two well-tempered steel coil springs furnish the centripetal force. The system being coupled is independent of gravity, and it is readily seen that the speed determines the position of the weighted arms, which, in turn, determine the angular advance of the eccentric and the consequent point of cut-off, the range of which is, we are informed, from zero to nearly three quarters of the stroke.

All parts of the governor are relatively at rest while running, and hardened steel ball and socket joints secure flexibility. The whole system is claimed to retain the well known advantages of slide valves, and to secure perfect immunity from the dangers of breaking or running off a governor belt, while the positive valve motion and freedom from all trip devices render the engine noiseless in operation. This system of cut-off is stated to be readily applicable, with economical results, to any throttling engine sufficiently substantial in its parts. Among the minor details may be mentioned a device in the drop hooks which obviates all lost motion or tendency to "kick out;" cylinder cocks which relieve automatically from water, and an ingenious device for oiling the crank pin from a can while running.

Fig. 2.

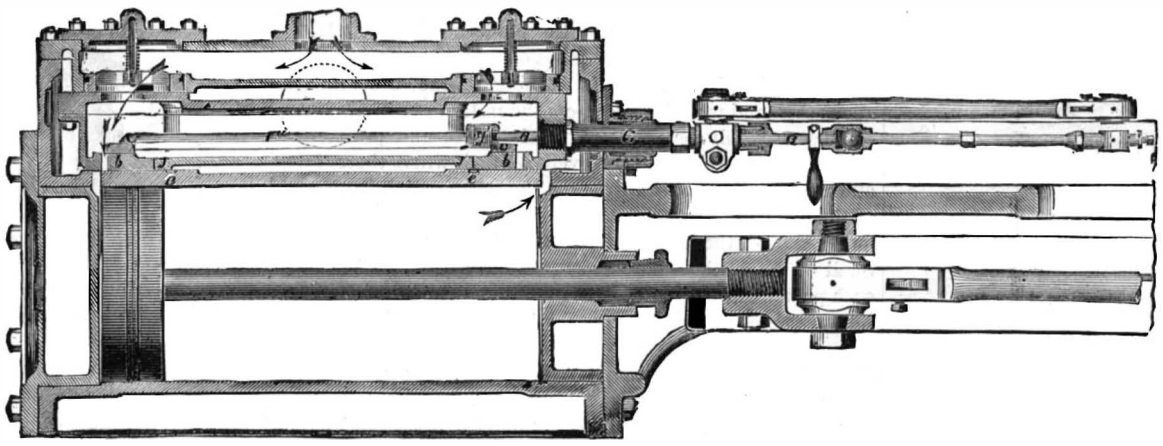
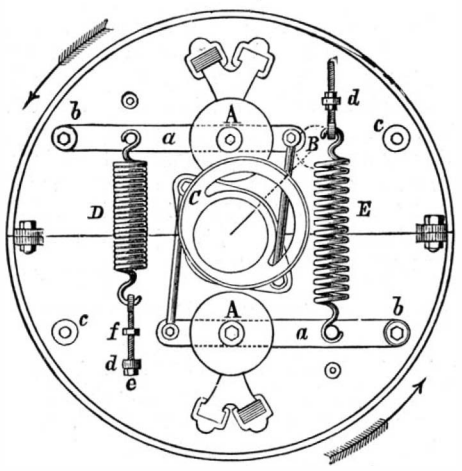
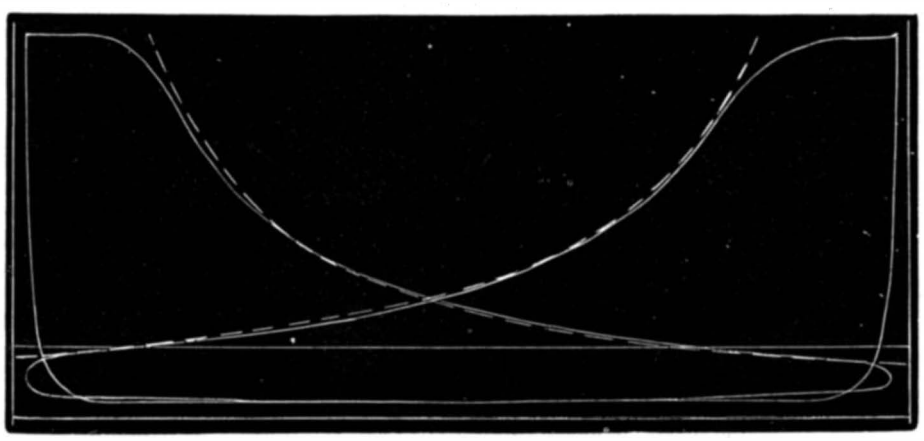


Fig. 3.



The piston speed is, for all sizes, 500 feet per minute.

Fig. 4.



The company claim, in the highest degree, and will in all cases specifically guarantee, power, economy, and especially absolute and sensitive governing. A perusal of their illustrated circular and a critical examination of the engine will repay the manufacturer or mechanic.

Three of these engines were exhibited at the Centennial International Exposition, Philadelphia, and two of them, of one hundred horse power each, are now furnishing the entire power at the Permanent Exhibition.

The company have recently opened an office and warerooms at 87 Liberty street, this city, where their engines can be examined, both in stock and running, and where information can be obtained.

New Inventions.

Mr. S. W. Poland, of Monson, Mass., has patented an improved Vapor Escape Attachment for Cooking Apparatus, consisting of jointed and adjustable escape pipes, which are connected by swinging horizontal portions to intermediate steam drums, and finally to an exit in the stovepipe.

A Galvanic Battery, intended especially for running light machinery, has been invented by Mr. C. A. Hussey, of New York city. When in use it has the functions of a "dry" battery, and is not liable to spill the liquid contents or to be deteriorated by the saturation of the exciting liquid by the zinc salts. There is an exterior zinc cup with an open bottom, and an interior porous cup with perforated bottom, the space between the two, and in the porous cup around the carbon pole, being filled with absorbent packing, which permits the liquids to be drained off at the bottom.

Mr. Adam Collignon, of Westwood, N. J., has patented an improved Steamer Chair, which is easily adjusted to a variety of positions as a reclining chair, and which may be folded into a compact form.

A new Flux Compound for Emery Tools, which is claimed by the inventor to cause remarkable resistance to abrasion, has been patented by Mr. August Cæsar, of New York city. It is composed of quartz, red lead, glass, saltpeter, and borax, mixed in certain proportions and treated in a peculiar manner.

An improved Carpet Lining, invented by Mr. R. J. Macdonald, of New York city, is made of paper stock or similar material, in a continuous sheet, and cut at intervals in such a manner that small portions of the sheet may be lapped under, forming spring supports for the carpet and providing pockets for the dust.

Mr. Daniel Martin, of Hotchkissville, Conn., has patented a Pocket Knife for Opening Cans, which is simply a knife of the usual construction, to which is added a short beveled blade for opening cans, a pin on the blade serving to assist in opening the knife and as a stop in opening cans.

An improved Wagon Seat Spring, invented by Mr. J. F. King, of Edwardsville, Kan., consists of two or more rigid bars jointed together, and having between them, near their joints, blocks of rubber, which are compressed when the bars are moved toward each other, and expand when the bars are released. Springs made on this principle are applicable to a variety of uses.

Mr. H. A. Walker, of Ranaleburg, N. C., has patented an improved Saw Cleaner for Cotton Gins, consisting of a series of notched wipers, composed of flexible material, and attached to the periphery of a drum or wheel which is rotated at the back of the gin saws.

Mr. J. H. Martin, of Hartford, N. Y., has patented a Combination Chair, a single piece of furniture, which is constructed to be used as a chair, an ironing table, a step ladder, and a commode, being adjustable to each use as desired.

A convenient form of Sealed Cans, for paints, canned goods, etc., invented by Mr. A. J. Nolty, of Chattanooga, Tenn., is made with a circular slot in the top, closed by a strip which is soldered on, this strip being provided with a ring at one end, by means of which it may readily be removed without the use of a knife.

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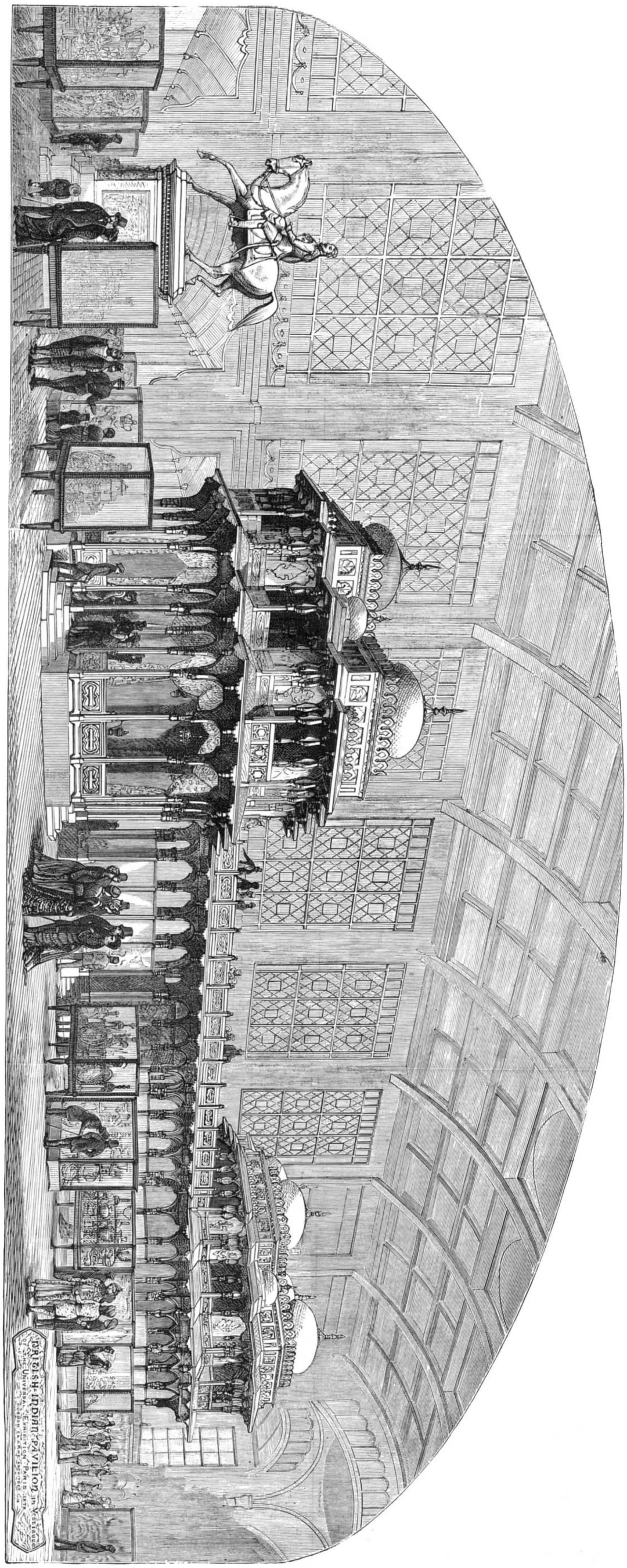

THE BRITISH INDIAN SECTION AT THE PARIS EXPOSITION.

THE BRITISH INDIAN EXHIBIT.

The main building of the Paris Exhibition is divided longitudinally into two sections, of which the eastern portion appertains to France, and the western to foreign countries. More than one fourth of this latter space is occupied by England and her colonies, British India being especially conspicuous. An interior view of the section appropriated for its exhibit we copy from the London *Graphic*. The greater part of the space is devoted to the display of the fine collection made by the Prince of Wales during his Eastern travels, and this collection will undoubtedly be one of the prominent features of the exhibition. His Royal Highness is described by the English press as being deeply interested in the work of rendering the exhibit under his charge as successful as possible.

Probable Iron Mines in Syria.

Professor Osborn, of Oxford, Ohio, has recently been examining some iron ore from the Lebanon Mountains of Western Syria, with these results:

"Among other minerals, a specimen of supposed iron ore has been brought from near the foot of a prominent Lebanon peak, well known to tourists as Jebel Keneiseh. The locality, as described to me by the finder, is on the French road from Beirut to Damascus, twelve miles east of Beirut. The specimen is not a good ore, and rather lean, containing only about twenty per cent of iron, and very silicious. But to me the specimen is suggestive. There must be a genuine ore somewhere in that region. This specimen is not an oxidized result of some nodule or mass of sulphide, which frequently occurs even in the blue limestone of this region and of other horizons where iron ore is not found. This is too silicious, and indicates an outcrop of magnetite or compact specular ore or red hematite. There seems, from the statement of the finder, to be a large number of fragments scattered around. I am somewhat acquainted with the country to the south, and there acres may be found covered with streaks and patches of extremely red soil, but this is the first specimen so nearly resembling iron ore that I have seen from this country.

"The particular interest associated with finding iron ore in this country is twofold. Geologically this land is Jurassic, or, of the higher horizon, Cretaceous, horizons in which it is not usual to find such ores as the ancients used from which to make iron, ores which were exclusively rich. Elba has no Jurassic formation, and its iron comes from Porto Ferraio, in a strictly plutonic region. Moreover, this land, historically, was spoken of as one from which iron could be taken, an assertion not yet verified. A discovery of true ore here would be scientifically and historically interesting, and I would suggest to tourists this summer to examine the region to the north and east of the locality above indicated for a true magnetite or specular ore (red), using the brown hematite specimens only as indications."

Grape Culture.

The following brief, practical, and condensed rules for the management of grapes were given by Dr. Whiting at the Farmers' Institute, recently held at Saginaw, Mich.:

The soil best suited for the grape is decomposing shale, but any good clay soil thoroughly drained will do.

The ground should be carefully prepared, and only well rotted manure used.

Decomposing turf is one of the best fertilizers; when it can be obtained, no other will be required.

The vines selected for planting should be good one year old layers or cuttings. They may look small, but will make the best vines.

Good culture is as necessary to the vine as to corn or cabbage.

Mulching and watering the first year should not be neglected if drought is excessive. One good soaking is better than many sprinklings. More water can be saved with a hoe than can be put on with a sprinkler.

In planting cut the vine back to two buds, whatever its strength or age.

Summer pruning consists in pinching off weak and straggling shoots in order to confine the sap to the main branches.

The first summer allow but one main shoot to grow. In the fall, after the first frost, cut all the summer growth back to within two buds of the ground.

The second year confine the sap to two branches, and in the fall cut back to three buds each.

The third year, if your vine has made vigorous growth, a few stems of grapes may be allowed to mature, but better take off all the fruit than to suffer too much to grow.

Too heavy bearing while young will weaken the vine for all future time. The trimming now depends on what kind of trellis you wish to cover.

After you have obtained a good vigorous root, you can make it grow in almost any place or shape you wish, by keeping the branches desired tied up, and all the others pinched back.

Each year a few of the strongest branches should be allowed to grow as bearers of fruit the following year.

In trimming cut away as much of the old wood as possible and save the new, as all the fruit buds are on the new wood.

You can easily tell how much to cut away by holding your new wood up to the trellis, and imagine a branch with three stems of grapes for each bud.

If you do not cut off enough in the fall, and you find that the vine is going to be too thick, do not fail to attend to it

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when the new shoots are from three to six inches long, in the spring, or while in blossom. As soon as the fruit is set examine the vine; spread out the new wood so that each bunch of grapes will hang free and clear; pick off all the small stems of fruit, and fasten the vines securely, so that the wind will not destroy your crop by breaking the young and tender branches.

When the wood has grown so that there are three leaves beyond the last bunch of grapes examine the vine, select the branches you wish to save for fruit bearing the coming year, and keep them tied up until they have grown as long as you wish to make use of. The ends of the other bearing branches should be pinched off as soon as they reach this point, "three leaves beyond the last stem of grapes."

Break off all shoots and laterals as fast as they make their appearance, but on no account injure the leaves on the bearing canes.

The fruit will color but not ripen if the leaves are destroyed.

Grapes for fall and winter use should be picked as soon as ripe, and when perfectly dry, packed in fine dry sawdust. Select your box or jar, cover the bottom with sawdust, then layers of grapes and sawdust alternately until full. Keep them in the coolest place you can find free from frost, until wanted for use.

THE PRODUCTION OF ARTIFICIAL MONSTERS.

It is well known that both animals and plants often yield progeny of strange and abnormal form, sometimes changing the whole aspect of the offspring, at others appearing as greater or less deformities. "Sports," "freaks of nature," "monsters," and like names are popularly applied to these phenomena, despite the fact that science has succeeded in reducing certain types under definite laws. Most commonly

Fig. 1.

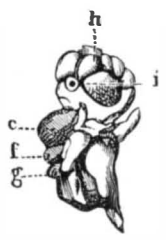
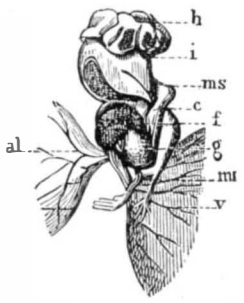


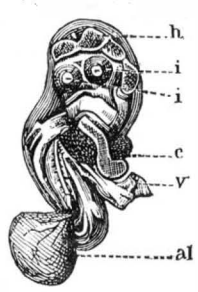
Fig. 2.



these organisms are sterile, but there are instances where they reproduce their kind and become a species. Geoffroy St. Hilaire, who perhaps made the deepest investigations ever conducted into the nature and causes of their production, first conceived the idea of artificially producing them, and to this end he began modifications of the physical conditions of the evolution of the chicken during natural and artificial incubation. He determined the fact that monsters could be produced in this way, but scarcely carried his investigation further. This work has been taken up by M. Dareste, and he has lately published a volume in Paris which recounts the results of a quarter of a century's experimenting. Eggs, he states, were submitted to incubation in a vertical instead of in a horizontal position; they were covered with varnish in certain places so as to stop or modify evaporation and respiration. The evolution of the chick was rendered slower by a temperature below that of the normal heat of incubation. Finally, eggs were warmed only at one point, so that the young animal, during development, was submitted at different parts to variable temperatures.

Fig. 3.

Fig. 4.

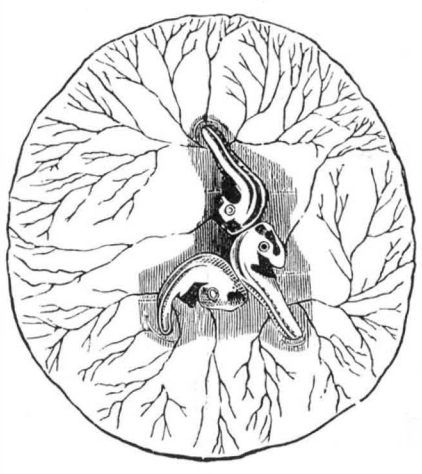


These perturbations resulted in the most curious and unlooked for deformities in the embryo, some being not alone peculiar to the bird, but being similar to those which have been recognized in many other animals, and even in the human species. The data obtained have been deemed so important that M. Dareste has recently received the Lacaze prize for physiology from the French Academy of Sciences.

It would be impossible, in the limited space at our disposal, to review even a fraction of the many forms of monstrosities which M. Dareste has discovered. Those that we give will, however, suffice to convey an idea of the wonderful variations produced. Fig. 1 is a chick embryo, with the encephalon entirely outside the head, the heart, liver, and gizzard outside the umbilical opening, right wing lifted up beside the head, and the development of the left one stopped. In Fig. 2 the encephalon is herniated and marked with blood spots, the eye is rudimentary and replaced by a spot of pigment, the upper beak is shorter than the lower one, while the heart, liver, etc., are all outside. In Figs. 3 and 4 the head is compressed, eyes well developed, but in the back instead of in the sides of the head; the body is bent, abdominal intestines not closed, heart largely developed and herniated. The literal references to the foregoing are: *am*, amnion; *al*, allantois; *v*, vitellus; *h*, encephalon; *i*, eye; *c*, heart; *f*, liver; *g*, gizzard; *ms*, upper, and *mi*, lower member.

The commonest case of monstrosity observed by M. Dareste has been that of the head protruding from the navel, and the heart or hearts above the head. This is a most extraordinary and new monster, and, if it persist, a chicken

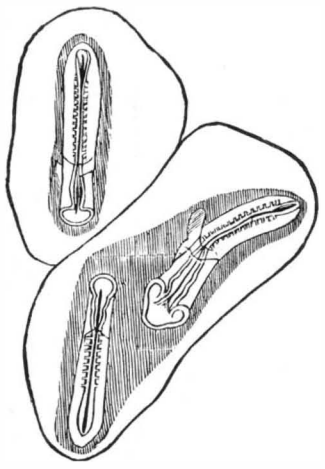
Fig. 5.



with its heart on its back, like a hump, may be expected. A curious fact discovered is the duplicity of the heart at the beginning of incubation, two hearts, beating separately, being clearly seen. Another anomaly consists in heads with a frontal swelling, which is filled by the cerebral hemispheres.

M. Dareste's artificial monsters are all produced from the single germ or cicatricule (as the white circular spot seen in the yellow of the egg, and from which the embryo springs, is termed). He has not yet been able to determine artificially the production of monsters, the origin of which takes place in a peculiar state of the cicatricule before incubation. But having submitted to incubation some 10,000 eggs he has obtained several remarkable examples of double monstrosities

Fig. 6.



in process of formation, some representations of which are given herewith. Fig. 5 shows three embryos, all derived from a single cicatricule. Fig. 6 represents three embryos from two cicatricules. On one side of the line of junction are two imperfectly developed embryos, one having no heart. The single embryo on the other side is generally normal, but has a heart on the right side. In Fig. 7 are twins, one well formed, the heart circulating colorless blood, the other having no heart and a rudimentary head. Fig. 8 exhibits a double monster with lateral union. The heads are separate, and there are three upper and three lower members, those of the latter on the median line belonging equally to each of the pair.

Fig. 7.

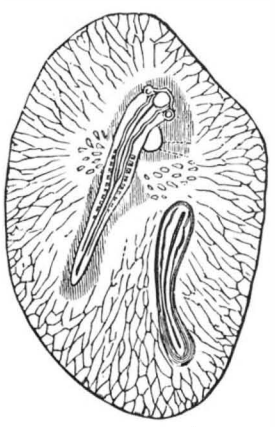


Fig. 8.

M. Dareste's work embodies a general theory of these singular organisms, which, it is believed, will be of much value to embryological science.

New Investigations on Glucinium.

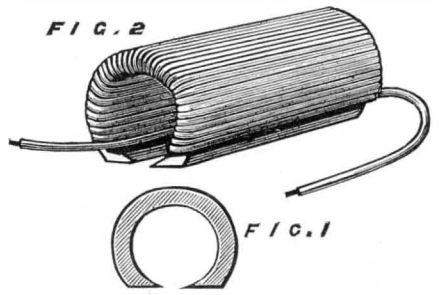
MM. Nilson and Petersson communicate to the French Academy of Sciences the following results of their late investigations into the physical properties and specific heat of glucinium: The metal is grayish, and of about the color of steel or tin. It is very light, has a density of 1·901 at 32° Fah., is hard, has a great tendency to crystallize, and when cast in globules breaks easily under the hammer. It does not fuse at temperatures at which sea salt easily melts, and is not altered by exposure to the air. It is unalterable by oxygen when at a red heat or by sulphur vapor. In the oxidizing flame it becomes covered with an oxide film, with no phenomena of ignition. It has no action on water, hot or cold. Hydrochloric and hydrosulphuric acids and hydrates of potash and soda are decomposed by it. It disengages hydrogen rapidly when heated. Nitric acid attacks it slowly, a small residue of silicic acid with a little iron and glucine resulting. The density of the impure metal has been determined at 1·9101. The specific heat averages 0·4084.

A Possible New Force in the Solar Rays.

M. Forssman, who has been making investigations on the action of variously colored lights on the galvanic conductivity of selenium, concludes that it is not the light vibrations or certain kinds of them that produce variations of conductive resistance, but vibrations of another order which he thinks have neither lighting, heating, nor chemical action. This opens the road to further researches to discover whether this hypothesis be true, as, if so, its verification would be of the highest scientific importance, and amount practically to the revelation of a new mode of motion.

How to make a Strong Electro-Magnet.

To make a Jamin magnet, take a piece of wrought iron pipe about 3 inches long by 1 inch diameter, file away one



side until through (see Fig. 1), and then, after softening it in fire, wind with cotton-covered wire in the direction of its length, as in Fig. 2. It is superior to the ordinary form of magnet in its great power, arising from several causes. The poles are close to one another, and have large surfaces, and, from their proximity, the part of the wire in the interior of the tube reacts on both poles, thus utilizing the battery power to the full.

A Salmon Disease.

A remarkable fatality has befallen the salmon in the rivers of Cumberland and Westmoreland, England. A short time ago large numbers of salmon were found dead on the banks or floating on the surface of the river Kent, and, though poisoning was suspected, the river watchers have been unable to find any trace of pollution, either willful or accidental. In most cases it was found that the fish were "kelts" or spawned fish, which had, as is frequently the case, succumbed to the effects of exhaustion after spawning; but the great number of fish dying in this way at one time was very remarkable. In the Eden, however, a more serious state of affairs exists. Large numbers of salmon—not only kelts, but clean fish lately arrived from the sea—appear to be affected with an epidemic which destroys hundreds of them. The head and tail first, and gradually the whole body, is attacked by a disease which appears to eat away the flesh, turning it white, and giving the fish the appearance of being affected with leprosy. Such fish are entirely unfit for food. Correspondents describe them as leaping out of the water, as if in pain, and in frantic efforts to escape; some return to the sea, but many perish in their attempts to reach the salt water. The salmon caught in the estuary are not diseased in this way, and, as the epidemic is said to be spreading to the trout, it would appear that some peculiar condition in the fresh water is the cause of the remarkable phenomena.

Improved Rolls for Beams.

Mr. Josef F. De Buigne, of Vienna, Austria, has recently patented a new method of grooving rolls, so that the groove forming the web of the beam or bar shall form an obtuse angle with the axis of the roll and with grooves which make the flanges. By this arrangement a vertical pressure is exerted at each pass at the same time upon the web and upon two of the opposite flanges, so that any desired sectional shape may be made by the use of horizontal rolls, only independent of the relative dimensions of flanges and web. The patent is offered for sale by Messrs. Wirth & Co., of Frankfort-on-the-Main, Germany.

A NEW EXPLOSIVE.—Professor Emerson Reynolds suggests a compound of 75 parts chlorate of potash and 25 parts sulphurea (a substance obtained from a waste product of gas manufacture), the ingredients to be mixed as required at the time of using.

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M. PLANTE'S NEW INVESTIGATIONS ON THE EFFECTS OF HIGH TENSION CURRENTS.

We have already noted several of the more important electrical phenomena observed by M. Planté by the aid of the powerful discharges of his secondary batteries. In the annexed engravings, which we extract from *La Nature*, are represented the apparatus he uses, and some new and interesting effects of the current. Fig. 1 shows the disposition of 400 secondary elements, divided into ten batteries of forty couples each. In his recent experiments with eight hundred secondary couples, another series of batteries is placed in an adjoining room, and all the batteries are suitably connected. To charge them, two to four Bunsen couples suffice, the latter being placed outside the room to avoid the effects of acid emanations. When the batteries have not rested inoperative too long, a few hours are sufficient to charge them. Then, by adjusting the commutators, the elements previously connected for quantity may be adjusted for tension, so as to expend either in a few seconds or a longer period, at the will of the operator, the large quantity of electricity resulting from the chemical action accumulated during several hours by the Bunsen couples.

The experiments have most frequently been made in the dark, so that the details of the luminous phenomena may be studied. The voltameter is represented at the moment when the electric current acts at its surface. Steam is seen rising, due to the powerful calorific effect.

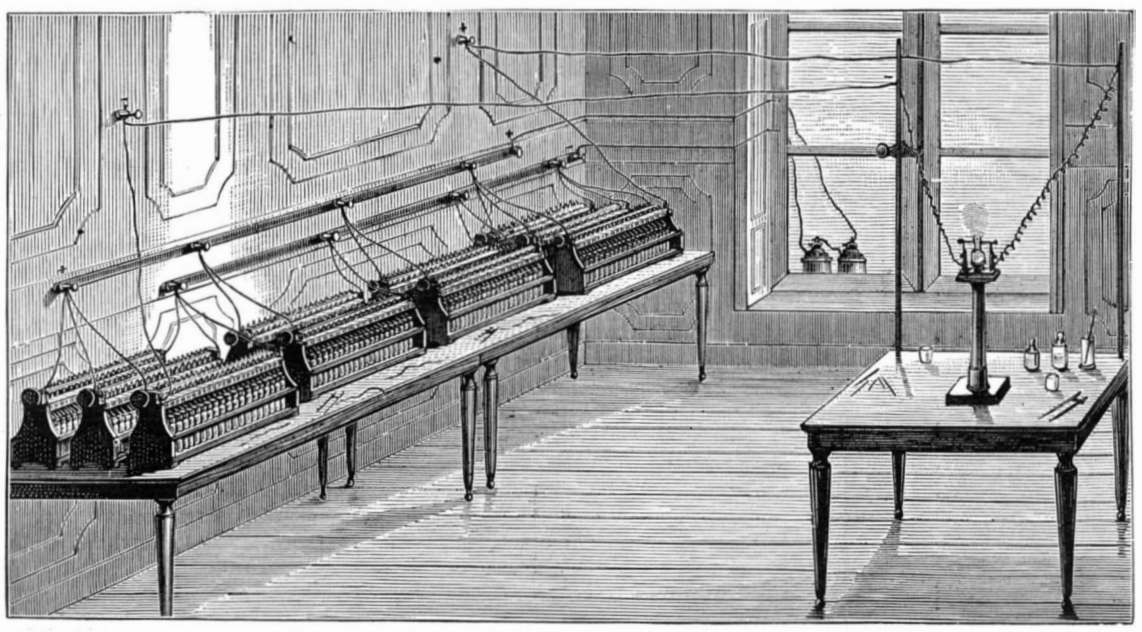

Fig. 1. PLANTE'S SECONDARY BATTERIES.

One of the most remarkable phenomena recently observed by M. Planté relates to the electric silicic light, regarding which we have already made some brief mention. If in a solution of nitrate of potash a platinum wire (inclosed in a glass tube and connected with a secondary battery of sixty elements) be placed, the pole of the battery being previously immersed, the glass melts at the end of the tube and expands with a brilliant light. The end of the wire becomes enveloped in a globe of melted glass (Fig. 2), and the light shines brilliantly while the discharge continues, until the glass, melting and cooling around the electrode, isolates it completely from the liquid. When a solution of sea salt is used in the voltameter, from two hundred and fifty to three hundred secondary couples are required to give the same effect. The saltpeter solution enables the result to be obtained with a much weaker current.

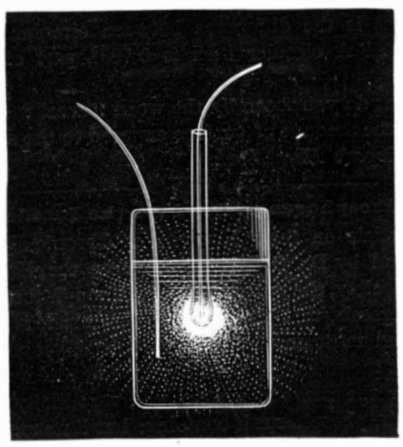

Fig. 2.

The peculiar vitreous light may be produced by applying either electrode against a plate of glass a little distance above the saline solution (Fig. 3). It is accompanied by a disengagement of white vapors, and the glass is strongly attacked. The same illumination may be produced along the sides of a porcelain cup. It seems probable that the brilliancy of the light may be attributed to the lime combining with the silex in the glass; but if, on the other hand, its spectrum be examined no appreciable lines are to be found. Nevertheless a fragment of calc spar, placed under the same conditions, gives a brilliant light and exhibits the characteristic calcium lines. The silicium lines being weak, they may not appear by reason of the luminous intensity of the spectrum formed; but the silicic origin of the light is demonstrated by the important fact that it appears on the contact of the electrode with pure silex in the state of hyaline quartz, Fig. 4.

While conducting these experiments M. Planté observed that the luminous rings formed around the positive electrode of a powerful battery sometimes remained engraved on the surface of the glass voltameter. This led him to attempt to utilize the electric current as a means of engraving glass plates. The glass is covered with a saltpeter solution, and in this is plunged (along the sides of the plate) a platinum wire communicating with a fifty or sixty element secondary battery. The other electrode is also of platinum, covered with isolating material except at its extremity, and this is used to touch the glass wherever the design is to be engraved. The work is done with great rapidity and delicacy, and remarkably fine lines are produced to any desired depth.

Natural History Notes.

Poison of Snakes.—The *Transactions of the Royal Society* contain a paper by Mr. Pedler, in which he publishes the results of his elaborate experiments on snake poison, which had for their object the discovery of an antidote, but which were unsuccessful. Ammonia, as an antidote for application to the wound, he has proved to be utterly worthless. Iodide of methyl and hydrochloric acid diminish the activity of the virus, and perchloride of platinum formed with it an almost insoluble and inert compound. Neither of these substances, when injected after the poison, proved capable of preserving life. In several instances, artificial respiration caused an apparent revival of life in persons and animals that seemed to be already dead, but in no instance did it avert the fatal issue.

Sophora Speciosa.—This leguminous plant, a native of Texas, has recently attracted the attention of botanists on account of its poisonous seeds—a character very unusual, if not entirely unknown, in any other plant of the large order to which it belongs, an order that furnishes us with the pea and bean and some other nutritious foods. The seeds of the plant have been described by Mr. Bullock at a meeting of the American Pharmaceutical Society. Professor H. Wood, Jr., has analyzed them, and detected what is apparently a new alkaloid, for which he proposes the name of *sophoria*. Half of one of the seeds is said to be sufficient to produce delicious exhilaration, followed by a sleep lasting one or two days.

Habits of Ants.—Sir John Lubbock continues his observations and experiments; he finds that ants recognize old acquaintances and speedily attack strangers. He doubts their vaunted intelligence, for example, in cases where a thin circle of glycerin bars their access to honey which they have already visited by a paper bridge; for, when the latter is taken away, they do not go to work and pile up grains of the surrounding earth (as they might do) and thus easily cross the glycerin barrier. Notwithstanding the many observers of the habits of ants, and the plentifulness of their nests, it is still doubtful how the latter are commenced. As to these insects intimating to each other their discovery of food, this does not necessarily imply any power of describing localities, for it seems that co-workers accompany each other to the discovered treasure rather by a simpler sign. Experiments, again, seem to negative the idea of these insects using sounds to acquaint their fellows of any repast they may come across. As to the affection of ants for their friends, this is outbalanced by their hatred of strangers. They are guided more by scent than by sight in following up tracks of food which has been shifted in position after they have once partaken of it, returned to their nest, and then again sallied forth in search of it. They avoid light when it is thrown into their nest, and congregate in the darkest corners. Taking advantage of this habit, and by a series of ingeniously contrived experiments, wherein strips of colored glass and shallow cells containing colored solutions—such as fuchsine, bichromate of potash, chloride of copper, etc.—were used, Sir John arrives at the conclusion that ants, like bees, are influenced by the sensation of color, though in the case of ants its effects, probably, are different from those produced on the retina of man. In the ants experimented upon, a marked preference was given by them to red; green followed, yellow came next, while to blue they appear to have a decided aversion. The longevity of these insects from these series of observations would appear to be greater than most authors admit; for some specimens in the experimenter's possession are now at least five years old and still lively.

Fig. 4.

The "Rain Tree" of Moyobamba.—A paragraph has been going the rounds of the papers describing, on the authority of the United States Consul in the province of Loreto, a tree existing in the forests near Moyobamba, in northern Peru. This tree was stated to absorb and condense the humidity of the atmosphere with such astonishing energy that the water may frequently be seen to ooze from its trunk and fall in rain from its branches in such quantities that the ground beneath was converted into a perfect swamp. Mr. Thiselton Dyer, the botanist, has investigated the subject, and in a short paper read before the Linnæan Society gives it as his opinion, based on information derived from Mr. Spruce, that the "rain tree" (*Tamia-caspi* of the natives) is the *Pithecolobium samar* of botanists, and the so-called "rain" the fluid excreta of young cicadas, which they squirt forth in slender streams as they feed on the juices of the foliage. The whole phenomenon is comparable to the production of honey dew from the lime by the agency of plant lice (*aphides*).

Fig. 3.

Effect of Growing Plants on the Air.—In a recent article, the eminent sanitarian, Professor Von Pettenkofer, of Munich, argues, from data collected by himself and others, that there is no superabundance of oxygen in the vicinity of growing vegetation; and that, as a matter of fact, so far as the supply of this gas is concerned, the country, with its boasted superiority, is not much better off than the city. This is quite the contrary of what has usually been taught.

A Self-fertilizing Cabbage.—Dr. Francis Darwin, in a recent lecture, says that "it is curious to find a plant adopting a new mode of conveying its pollen when the old one fails. Thus, a wild cabbage-like plant which grows in Kerguelen's Land is now fertilized by the wind; that is, it produces dry, dust-like pollen, which is easily carried by the wind. Now, this cabbage is the only species in the enormous order of the *Cruciferæ* which is not fertilized by insects; so that we may be certain that some change has taken place for which good reasons exist. And the reason of the change is, no doubt, that the insects in Kerguelen's Land are wingless, and therefore bad distributers of pollen. And, to go one step further back, the reason why the insects are wingless is to be found in the prevalent high winds. Those insects which attempt to fly get blown out to sea, and only those are preserved which are gradually giving up the habit of flying. Thus the pollen of the cabbage has to learn to fly because the insects will not fly for it."

Protective Mimicry in Caterpillars.—At a recent meeting of the British Entomological Society, Sir John Lubbock read a

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paper on the coloring of British caterpillars. Accepting the theory laid down by Darwin and others, that dull colored, green, and smooth skinned caterpillars are eaten by birds, etc., while spiny, hairy, and brightly colored species are rejected, the author stated that, by the statistical method, it was shown that no hairy caterpillars are green; while, on the other hand, a large majority of black and brightly colored species are hairy or otherwise protected.

Danger from Cats.—A writer in the *Lancet* states that it is a mistake to suppose that there is no danger in the bite or scratch of one of these animals. There have been abundant and melancholy proofs of the peril of contracting hydrophobia from cats; and the danger is scarcely less than that which attends an injury inflicted by a dog.

A New Method of Preserving the Colors of Dried Plants.—It is pretty well known that plants treated with alcohol can have their natural colors preserved for a long time; but still they begin to fade far too soon and darken. To avoid this, resort may be had to the following process, which is said to yield excellent results:

Dissolve one part of salicylic acid in 600 parts of alcohol, and heat the solution to the boiling point in an evaporating dish. Draw the plant slowly through the liquid, wave gently in the air to get rid of superfluous moisture, and dry between folds of blotting paper several times repeated. In this manner the plants dry rapidly, which is a great gain, and they thus furnish specimens of superior beauty. The addition of a drachm of red Condy's fluid to the water contained in a flower vase will preserve the freshness of cut specimens for three or four days.

A Gardener Bird.—Under this title the *Gardener's Chronicle* gives a description, with illustrative woodcuts from original sketches drawn on the spot by Signor Beccari, of a bird which is not only an expert architect—building a nest like the bower bird of Australia—but also a gardener, laying out a garden in front of it. The bird is a native of New Guinea, and makes its nest of the stems of an orchid. In front of the nest a dressed lawn of moss is formed, on which the attentive male places, day by day, for the delectation of his mate, flowers and fruits of bright colors and pleasing flavor. The orchid, which belongs to a hitherto unknown species, has been described in full by Professor Reichenbach.

"Protective Resemblances" in Fungi.—The eminent authority on mushrooms and toadstools, Mr. Worthington G. Smith, figures and describes, in a recent number of the *Gardener's Chronicle*, specimens of a toadstool (*Agaricus furfuraceus*) which had assumed the habit of a morel (*Morchella*). There is no doubt that these plants, which were first thought to be morels, are true specimens of *Agaricus furfuraceus*, for Mr. Smith mentions that many intermediate forms were found associated. There have recently been found many specimens of toadstools with the habit of other species, and they have generally been accounted for on the somewhat fanciful supposition of "protective resemblance;" but, unfortunately for this theory, most of the cases have been of poisonous species taking the habit of edible ones. In this case, as Mr. Smith points out, there would be little advantage to *Agaricus furfuraceus* in assuming the habit of the much sought after edible morel; there would certainly be just as little to an unskillful collector.

The Oaks of the United States.—In 1876, Dr. Englemann, after a study of the oaks of the United States, read a paper on the subject before the St. Louis Academy of Sciences, giving as the results of his investigations an entire revision of this extensive and perplexing genus. In a subsequent paper published in the *Proceedings of the Academy*, he has corrected some errors and modified his former arrangement of the genus.

The collection of oaks at the Centennial Exhibition furnished interesting facts. The black oaks grow, on an average, twice as fast as the white oaks. The heartwood of the latter is always readily distinguishable, but that of the black oaks is scarcely, if at all, darker than the sapwood. The black oaks of the present day are confined to America, principally to the Atlantic region, but in the Tertiary period they extended into the Old World. Occasionally black oaks are found with cup scales thickened at the base. Professor Sargent has collected, near Cambridge, acorns of scrub oak (*Quercus ilicifolia*), whose cups had this peculiarity, and it does not seem to be rare at all in the northern forms of red oak.

As what are considered hybrid oaks are abundantly fertile, and their acorns capable of germinating, the only test is the rarity and individuality of the form, and its character intermediate between two well established species which occur in the neighborhood. Hybrids seem to be much rarer between white oaks than among black oaks; or it may be that they are more difficult to discover. Dr. Englemann knows of only three, all of them pointing to the white oak (*Q. alba*) as one of the parents. Of black oaks he names seven hybrids, one of them, between the scarlet oak and the willow oak, being Bartram's oak (*Q. heterophylla*). He was formerly inclined to believe the latter to be a distinct species. The type specimen of Michaux was long ago destroyed, but within the last ten or fifteen years the tree has been rediscovered; and now numbers of individuals are known in low woods on both sides of the Delaware, below Philadelphia, often in groups together, probably the offspring of some few original hybrid trees.

The Jelly Fish.—The jelly fish have at length been shown to possess a nervous system, a point which had been considered doubtful; and one that was difficult to demonstrate on account of the gelatinous and deliquescent nature of the fish, which rendered microscopic examination almost impossible.

Ehrenberg had, indeed, asserted the fact, but Escholtz and others had failed to discover any traces of nerves in the largest jelly fish examined. Mr. Romanes, in a second communication to the Linnæan Society on this subject, has thrown a flood of light on the first beginnings in the animal kingdom. By a series of physiological researches, the microscope being only used as an auxiliary instead of being solely relied on, as by former inquirers, he has succeeded in proving satisfactorily that the jelly fish, or *Medusidæ*, have a nervous system. In view of the latter fact his experiments were perhaps hardly as satisfactory to the jelly fish selected for experimenting on as to himself and the scientific world. Every one knows, at least from engravings, the umbrella or mushroom form of the jelly fish. The stem part, it appears, has no tissue elements possessing a properly ganglionic function, or, to state it less scientifically, there are no nerve centers in this part of the jelly fish to exercise control over the movements of the umbrella part or swimming bell. These movements are regulated from the margin. When Mr. Romanes cut off the margin, the pulsations of the swimming bell at once ceased, and were not again renewed; but the severed margin continued its rhythmical pulsations for some time, and as regularly as the entire bell had pulsated before the operation. The whole of the muscular sheet which lines the cavity of the bell is pervaded, it seems, by a dense meshwork of nerve fibers, which serve to carry ganglionic impulses from the margin over the whole expanse of the muscular sheet.

Dreaming of Plants.—Dr. Francis Darwin, in his recent paper on the analogy between plant and animal life, says:

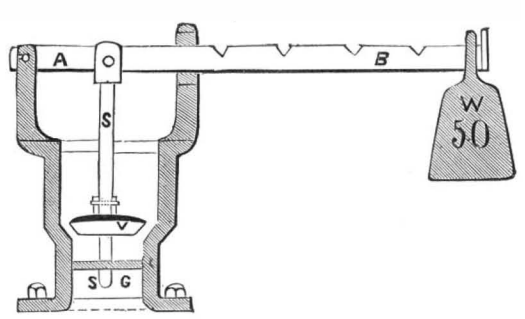
"There is one, but only a fanciful resemblance between the sleeping of plants and animals, namely, that both have the power of dreaming. I have been sitting quietly in the hothouse at night waiting to make an observation at a given hour, when suddenly the leaf of a sensitive plant has been seen to drop rapidly to its fullest extent and slowly rise to its old position. Now in this action the plant is behaving exactly as if it had been touched on its sensitive joint; thus some internal process produces the same impression on the plant as a real external stimulus. In the same way a dog dreaming by the fire will yelp and move his legs as if he were hunting a real instead of an imaginary rabbit."

Purple Oysters.—Last autumn the oysters in the Bay of Arcachon (France) acquired a very remarkable violet color. M. Descoust finds that this coloration is due to the presence in the oyster basin of large quantities of one of the rhodosperm seaweeds (*Rhytiphtœa tinctoria*), the spores of which are very highly colored. He finds that the coloring matter of these spores is assimilated by the oysters, and retained by them, more or less modified, in the lobes of the mantle and the branchiæ, and that they cannot get rid of it unless the water of the oyster parks is sufficiently diluted by rains. Last summer the drought was extreme all about the basin of Arcachon; hence the oysters became gorged with the coloring matter, the water of the parks not being sufficiently diluted to dissolve the latter.

Silk from Mussels.—A German naturalist, Tulberg, suggests the industrial application of the products of the mussel. The well known *byssus*, or strong silky threads which these animals spin in order to fasten themselves to rocks and stones, is pointed out as a probable raw material to rival the somewhat similar threads spun by the silkworm. The threads of the *pinna*, a mollusk allied to the mussel, have been worked into fine fabrics and made into gloves, and have, for a long time, been in common use among the poorer class of girls and women in Italy for such purposes. The toughness of the *byssus* of the mussel is a strong recommendation in favor of its adaptation to some such use.

The Safety Valve.

The form and construction of the indispensable adjunct to the steam boiler illustrated herewith are of the highest importance, not only for the preservation of life and property, which would in the absence of this means of safety be constantly jeopardized, but also to secure the durability of the steam boiler itself. B is the lever; A, short arm of lever; S S, stem; V, valve; G, guide; W, weight.



Increasing the pressure to a dangerous degree would be impossible in any boiler, if the safety valve were what it is supposed to be—a perfect means for liberating all the steam which a boiler may produce with the fires in full blast, and all other means for the escape of steam closed. Until such a safety valve shall be devised and adopted in general use, safety from gradually increasing pressure must depend on the attention and watchfulness of the engineer.

We have decidedly too much theory on the safety valve, and most of this theory is the merest vagary, which it is impossible to harmonize with experience and sound practice. All that the safety valve needs to make it what it was intended to be, is, first, an orifice proportioned to the grate surface; second, simplicity of construction; third, directness of action.

Q. What is the object or use of the safety valve? A. It is a valve intended to relieve the boiler from extra pressure, and to prevent bursting, collapse, or explosion.

Q. What do you consider a proper proportion for the safety valve of a boiler? A. The area of the safety valve should be one half square inch to each square foot of grate surface.

Q. Will this amount of opening of safety valve be safe for any ordinary pressure? A. Yes; it will be safe for any pressure from 10 pounds to the square inch up to 100 pounds.

Q. Is an enlargement of the safety valve greatly beyond what is customary in common practice dangerous? A. Yes; if such a safety valve by any accident should be knocked or lifted suddenly from its seat, it would probably cause the destruction of the boiler.

Q. Should every steam boiler have two safety valves? A. No; one safety valve of suitable proportions, and in good order, is sufficient.

Q. How should the safety valve be kept or cared for? A. It should always be kept as free as possible from dust and ashes, and all its working parts in good order.

Q. How often should the safety valve be moved? A. At least once a day, more particularly in the morning.

Q. Why should the safety valve be moved in the morning? A. So as to be sure that it is in good working order before starting the fire.

Q. What are the most important principles to be adhered to in the construction of the safety valve? A. Simplicity of construction, directness, and freedom of action.

Q Does the safety valve become worn and leaky by the continual action of the steam? A. Yes; all safety valves become leaky, and ought to be ground carefully on their seats.

Q. What is the best material to use for grinding safety valves? A. Pulverized glass, grit of grinding stones, or fine emery.

Q. Should safety valves be constructed with loose or vibratory stems? A. Yes; as the rigid or solid stem is apt to become jammed by the canting of the lever and weight, and in such cases the higher the pressure the more difficult is the action of the valve.

Q. Is the marking on safety valves sometimes incorrect? A. Yes; decidedly so.

Q. How can you tell whether the safety valve lever is marked correctly or not? A. By calculation.

Q. How do you square a diameter? A. Any diameter multiplied by itself is squared; as, for instance, 10 squared equals 100.

Q. Why do you multiply the square by 0·7854? A. By squaring the diameter we get square inches, and if we multiply by 0·7854, we get circular inches.

Q. What is the difference between circular and square inches? A. A circular inch is 0·7854 part of the square inch.

Q. What do you mean by the word "area"? A. By area we mean the amount of surface exposed to the action of the steam.—*Roper's Hand Book.*

Phosphorus as Food for the Intellect.

In an article on the "Hygiene of Chronic Nervous Diseases," read by Dr. G. M. Beard before the Kings County Medical Society, the author says: Although the generalization of Agassiz, that fish feeds the intellect, is among the wildest and most unscientific ever made, yet there is little doubt that the so-called "sea food," fish and oysters, is excellent for the nervous system, and very likely in part by virtue of the phosphorus it contains; but it no more feeds the intellect than phosphorus given in any other way. A healthy brain and an intellectual brain are not synonymous. One may be perfectly well, and, at the same time, perfectly stupid; a fool may eat like a lower animal, while the great philosopher barely keeps himself alive. While food is essential to thought, yet the force in food is not converted into thought-force. Good thinkers, like good athletes, are usually liberal feeders; but thousands who eat as much or more have very little intellect or muscle. The effect of a diet largely of fish seems to be sedative, calmative, like that of bromide of potassium, or phosphorus, or electricity—like these remedies, producing dullness rather than intellectuality, and inducing a disposition to sleep more than to think; not accelerating but slowing down the wheels of the mind, and therefore excellent and adapted for the nervous, and overworked, and overworried. The mistake of Agassiz was analogous to the mistake of the Italian physician, Paggioli, who used electricity on the brains of children, in order to stimulate their intellects and help them get their lessons and take the first prizes in school.

The Late Mr. A. T. Stewart,

The millionaire, once came to the conclusion that, although advertising was a good thing as a ladder, it was of no great benefit to him, as his name sold the goods. As a test, one department only of his establishment was advertised. Its business overtopped that of the others so immediately and so largely, that Mr. Stewart concluded that to get the full power of his name it must appear in printer's ink. His advertising managers say, "from that time he advertised more largely than ever in the papers."

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The Opening of the Paris Exposition.

The International Exposition of 1878 in Paris was formally opened on May 1, with the usual ceremonies attending such events. President MacMahon, accompanied by the Prince of Wales, the Prince of Orange, and many other royal personages, was received by the Minister of Commerce, amid the salutes of a large body of soldiers. The Minister delivered an address, in which he thanked the foreign countries which had responded to the appeal of France for contributions of manufactures and art treasures. President MacMahon then pronounced the Exposition open, when the fountains were opened, salutes were fired, and the flags on the buildings were hoisted. The distinguished party made a tour of the various edifices, and was received in the American section by Commissioner McCormick and a company of United States marines.

According to all accounts the show is in a very backward state. In the Swiss, Chinese, Japanese, and Russian sections most progress has been made and a fine exhibit will be displayed; but it is said that no contribution will compare with that of England and her colonies.

The New York *Tribune's* correspondent, with regard to the merit of our American display as compared with the exhibits of other nations, says that "the question can be answered better a month hence than now; but one or two things are as clear now as they will ever be. Our section is next to the British; how do the two compare? The British section is about six times as big as the American, filling quite one fourth of the whole building assigned to the non-French part of the world. We are about half as large as Belgium, two thirds as large as Austria, a little less than China and Japan together, about on a level with Russia, with Italy, and with Switzerland. We are slightly larger than the Netherlands. We occupy nearly twice the space that South America fills, but South America, re-enforced by Denmark and Greece, which are alongside, covers as much ground as the United States of North America.

"This is a rough, and, if you like, a vulgar method of comparison, but it is one a good many people will make. We have, moreover, a reputation in Europe for valuing mere bigness more than other nations, and if that be our standard, and we are to be judged by it, we certainly do not stand well. Our only chance is to surpass other nations in the general excellence of our modest contributions; to surpass them in variety, in sound workmanship, in finish, in novelty of invention, in the practical usefulness of the things we show. Perhaps we shall, but what I said about the hurry in which our things have been got together, and the utter refusal of many great houses to contribute, hardly looks like it. We shall fill all the space we have, and fill most of it well, I do not doubt. But the American who expects his country to stand anything like as well here as we did in Philadelphia, will be disappointed. To take one or two examples in a single department, that of machinery, we shall have not a single large printing press, but two sewing machines, and but one collection of machine tools, that of the Brown & Sharp Manufacturing Company, of Providence, R. I. One is almost tempted to say we had better not have come here at all than come with such a meager display. It should be understood that we could have had as much space as Great Britain if we had applied for it."

A Great Flour Mill Explosion.

A terrific flouring mill explosion occurred on the evening of May 2, in Minneapolis, Minn., which involved five mills adjoining the one in which the disaster originated, together with other buildings, and caused a loss estimated at a million dollars, besides the destruction of nearly a score of lives. The cause of the casualty is ascribed to an explosion of gas in the middlings purifiers, and also to the sudden combustion of the fine dust which probably pervaded all parts of the establishment. This last seems to have been the most likely cause. It is now well known that many substances, such as coal dust, saw dust, starch, and flour, when suspended in the atmosphere, in a finely comminuted state, are highly explosive, and in flouring mills especially there are numerous instances on record where sparks from the stones have ignited this dust, and produced all the effect of a gunpowder explosion. In such cases, however, it is always difficult to determine accurately the true cause of the accident, and the same, as in the example of the recent candy manufactory explosion in Barclay street in this city (probably due to ignition of fine starch), is thus left in doubt or ascribed to spontaneous combustion. The curious feature of this Minneapolis calamity is the successive explosion of a number of mills, the blowing up of the first acting upon the others, it would appear, not merely by communication of flames, but by concussion, as sometimes is true of gunpowder mills. Further details of the disaster will perhaps shed more light on this point; but it is none the less certain that improved safeguards against dust explosions might well engage the attention of inventors.

Opening of a New Elevated Steam Railway in New York City.

The first trip over the "Gilbert" Elevated Railway from Trinity Church to Central Park, in this city, was made on April 30th. The train consisted of a locomotive and four cars containing some 200 passengers. The speed, at first slow, was gradually increased to about 25 miles an hour, and the terminus in Fifty-ninth street was reached in 17 minutes. It is expected that the same distance will ordinarily be run by through trains in 12 minutes, and by way trains in 22 minutes. A failure in steam caused a delay on the return journey which occupied 32 minutes. The curves were passed easily and without jarring, and over the entire line the motion was smooth and uniform.

The new passenger cars are 37 feet 10 inches in length by 8 feet 9 inches in width, and will accommodate 48 persons each. The doors are placed at the ends, but it is intended that some of the vehicles shall be fitted with compartments. The decorations inside and out are very tasteful, and the unusually large windows will render the cars airy and comfortable for summer travel. The passage of the trial train was received with much enthusiasm by people along the route. Several trains have run over the road carrying passengers, but operations will probably not be regularly begun until the completion of the stations, now in rapid process of erection.

The Gilbert elevated road, it will be remembered, is a huge iron bridge, which, so far as completed, extends from Morris street along New Church to Church street, thence along Murray street, College place, and Chambers street to West Broadway, which it follows until it crosses Canal street and enters upon South Fifth avenue. Along this thoroughfare and West Third street, into which it turns, the road obscures the lower stories of buildings and works a great injury to private property, for which the owners receive no compensation. After leaving West Third street it turns into the splendid street known as Sixth avenue, and straddles the car tracks on that street up to Central Park at Fifty-ninth street. The distance is about 4½ miles. With the east side division, on which work has not yet begun, the total length of the line will be 22 miles, occupying and disfiguring the finest avenues in New York city.

The Natural Dissemination of Gold.

The results of recent investigations only go to confirm more and more the opinion long held by geologists as to the wide distribution of gold,

Mr. Henry G. Hanks, in a paper read by him before the California State Geological Society, on the "Divisibility of Gold" (see SCIENTIFIC AMERICAN SUPPLEMENT, No. 118), has recently added, as the result of his personal observations, many valuable facts in addition to what was already known on the subject, all tending to give further evidence as to the omnipresence of the precious metal in the earth's crust.

Of all the interesting examinations that have thus far been made to obtain information on this subject, the most curious, perhaps, were those that followed the investigations of Mr. Eckfeldt, the principal assayer of the United States mint at Philadelphia, a few years ago.

Underneath the paved city of Philadelphia there lies a deposit of clay whose area, by a probable estimate, would measure over three miles square, enabling us to figure out the convenient sum of ten square miles. The average depth is believed to be not less than fifteen feet. The inquiry was started whether gold was diffused in this earthy bed. From a central locality, which might afford a fair assay for the whole, the cellar of the new market, in Market street, near Eleventh street, some of the clay was dug out at a depth of fourteen feet, where it could not have been an artificial deposit. The weight of 130 grammes was dried and duly treated, and yielded one eighth of a milligramme of gold—a very decided quantity on a fine assay balance.

It was afterwards ascertained that the clay in its natural state loses about fifteen per cent of moisture in drying. So that, as it lies in the ground, the clay contains one part gold in 1,224,000. This experiment was repeated upon clay taken from a brickyard in the suburbs of the city, with the same result.

In order to calculate with some accuracy this body of wealth, blocks of clay were cut out, and a cubic foot (as it lies in the ground) found to weigh 120 pounds, nearly, making the specific gravity 1·92. The assay gave seven tenths of a grain of gold to the cubic foot. Assuming the data already given, it was ascertained that there were 4,180 millions of cubic feet of clay under the streets and houses, in which securely lay 126 millions of dollars; and if, as was pretty certain, the corporate limits of the city afforded eight times this bulk of clay, more gold lay therein than had as yet been brought from California and Australia.

From these figures it is apparent that, every time a cart load of clay is hauled out of a cellar, enough gold goes with it to pay for the carting; and, according to Mr. Eckfeldt's calculation, if the bricks which front the houses of the city could have brought to their surface, in the form of gold leaf, the amount of gold which they contain, there would appear a glittering star of two square inches on every brick.

The Total Eclipse of the Sun.

On the 29th of July next a total eclipse of the sun takes place under such circumstances as to present opportunities that occur scarcely once in a generation, for the study of some of the most interesting phenomena with which astronomers have to do. The path of the totality of this eclipse runs diagonally across the center of the United States from Montana to Texas, and is somewhere about 140 miles wide. Many of the best points for observing the eclipse are therefore directly accessible by railroad, and several expeditions might be sent out fully equipped to as many different points, without spending so much money upon them all as it would ordinarily take to equip a single expedition to a more distant point.

Recent discoveries have rendered it probable that most of the meteorological changes in progress upon this planet are caused by events taking place upon the sun, and many questions relating to the physical constitution of that orb, and the changes there taking place, can only be studied during a total eclipse. It is said by Admiral Rodgers, of the Naval Observatory, that the sum of the opportunities which all the astronomers of the world can get for observing such eclipses does not exceed five or six hours in a century, and it is therefore important that every advantage should be taken of the very favorable conditions for observation under which the present eclipse occurs. All the principal European governments recognize the importance of studying the phenomena attendant upon the total eclipses, and send out costly expeditions, even to their antipodes when necessary, for this purpose; and there is no doubt that there is a general impression abroad that our government would make ample provision for the study of a matter of such general interest, that is visible almost exclusively within our borders, or the different foreign governments would no doubt be preparing to organize expeditions for observation on our territory. Our government, however, has so far done nothing, and it is possible that one of the best opportunities that may occur in many years for the study of solar phenomena may pass away without any advantage being taken of it.

The Naval Observatory is awake to the importance of the occasion, and has asked Congress for an appropriation of $8,000 for the purpose of sending off seven expeditions, two of which it is designed to send to Montana, two to Texas, two to Colorado, and one to Wyoming, each to consist of three astronomers. The sum asked for was simply to pay traveling expenses and the cost of transporting and setting up the instruments in their temporary observatories, nothing being requested for salaries, as the most eminent astronomers will gladly volunteer their services for such an important occasion.

Petroleum Tanks.

Dr. Stevenson Macadam states that a lead tank will spoil the oil in a week, causing it, when burnt, to choke the wick so that the latter has to be trimmed several times in an evening. If the lead be bright the oil will be spoilt in a day. An iron tank does not much damage the oil for illuminating purposes, but it darkens the color rather considerably, and causes it to throw down a rusty-colored deposit. Zinc, ordinary tin solder, and galvanized iron, all spoil the oil. If a metallic tank must be used, let it be made of tin, copper, or tinned copper, and be sure that no common solder containing lead is used in making it. These metals do not seriously damage the oil, but if it be left in contact with them for some months, it will somewhat deteriorate. Stoneware or slate is suggested as being superior to any metal that can be used for petroleum tank making.

Singular Effect of Lightning.

Les Mondes notes a curious instance of where lightning striking frequently at the same point has gradually killed vegetation over a considerable area in the vicinity. The current after entering the earth made a deep hole some four inches in diameter. For some reason repeated strokes, during the last five or six years, have fallen at this point, and every year the circle of dead currant bushes around it has widened. At present the affected area has a diameter of over 20 feet, and a large cherry tree some twelve years old recently died. Fresh hardy bushes and shrubs planted within the boundary die within two years. It would seem that the lightning strokes have some influence in thus destroying vegetation, possibly by producing in the soil chemical compounds injurious to plants.

To Color Photographs.

Take a strongly printed photograph on paper, and saturate it from the back with a rag dipped in castor oil. Carefully rub off all excess from the surface after obtaining thorough transparency. Take a piece of glass an inch larger all round than the print, pour upon it dilute gelatin, and then "squeegee" the print and glass together. Allow it to dry, and then work in artist's oil colors from the back until you get the proper effect from the front. Both landscapes and portraits can be effectively colored by the above method without any great skill being required.

Cinders in the Eye.

To the Editor of the Scientific American:

Having noticed two communications in your journal lately under the above heading, permit me to give you a very simple remedy I have used for years with success: A small camel's hair brush dipped in water and passed over the ball of the eye on raising the lid. The operation requires no skill, takes but a moment, and instantly removes any cinder or particle of dust or dirt without inflaming the eye.

C. G. E.

New Binoxide of Manganese Element.

M. Gaiffe has recently made a new galvanic element, which consists of a carbon cylinder, perforated with numerous holes, in which grains of binoxide of manganese are placed, and a rod of amalgamated zinc. The liquid is a 20 per cent solution of neutral zinc chloride, free from lead. Oxide of zinc is formed, which falls in pulverulent state to the bottom of the containing vessel.

A HUGE BALLOON.—The dimensions of M. Giffard's captive balloon, which is being constructed in Paris, are 180 feet by 118 feet. The car will contain fifty persons, and the cable will be about 2,000 feet long.

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Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

The Buckeye Engine Co. make a specialty of fitting plain engines with their Automatic Cut-off and Condensers; 30 to 60 per cent economy and perfect governing guaranteed. 87 Liberty St., N. Y.

Vertical Scientific Grain Mills. A.W.Straub & Co.,Phila.

For Town and Village use, comb'd Hand Fire Engine & Hose Carriage, $350. Forsaith & Co., Manchester,N.H.

Bristol Machine Works For Sale. Facilities for all kinds of work. For full particulars, address Bristol Machine Works, Bristol, Pa.

Climax Washing Machine. Reliable Agents wanted. Descriptive circulars furnished. N. C. Baughman & Co., York, Pa.

The great Wheelock Engine, which furnishes the power to the machinery of the American Exhibit at the Paris Exposition this year, is lubricated by Patent Lubricene and Cups. Our exhibit will equal that which we made in Philadelphia in 1876. R. J. Chard, 134 M. Lane, N. Y. city.

Wanted.—A Back Geared, Screw Cutting, Foot Power Lathe. W. J. G., P. O. Box 295, N. Y.

A Microscope with 100 mounted objects for one dollar; circulars free. Address D. L. Smith, Waterbury, Ct.

Velvet Looms Wanted.—Manufacturers please send price lists to W. Lilienthal, 40 Lispenard St., N. Y. city.

Electrical and Mechanical Engineer and Expert. James Hamblet, 114 Tremont St., Boston, Mass.

Wanted.—Cash prices and description, 15 and 30 horse power Stationary Engines and Boilers. Newell Sanders, Chattanooga, Tenn.

Wanted cheap for cash.—A good second-hand Back Geared Screw Machine. Address, giving maker's name, where to be seen, size of hole in spindle, and full particulars, H. A. B. Weymer, 52 N. 6th St., Philadelphia, Pa.

For New and Second Hand Boilers, send to Hilles & Jones, Wilmington, Delaware.

Friction Clutches for heavy work. Can be run at high speeds, and start gradual. Safety Elevators and Hoisting Machinery a specialty. D. Frisbie & Co., New Haven, Ct.

Polishing Tools and Supplies. Send for new price list. Greene, Tweed & Co., 18 Park Place, N. Y.

For Mill Gearing, Shafting, Pulleys, and Hangers, address T. B. Wood & Co., Manufs., Chambersburg, Pa., for price.

Steam Yacht "Hiawatha" for sale.—Length, 40 ft.; beam, 8 ft. 5 in.; engine, 12 H. P.; speed, 12 miles. For particulars apply to J. M. Meredith, Exr., Maiden Creek P. O., Berks Co., Pa.

24 inch Second-hand Planer, and 12 inch Jointer, or Buzz Planer, both in first-class order, for sale by Bentel, Margedant & Co., Hamilton, Ohio.

Wrenches.—The Lipsey "Reliable" is strongest and best. Six inch sample by mail 60 cents. Roper Caloric Engine Manufacturing Co., 91 Washington St., N. Y.

Cornice Brakes. J.M. Robinson & Co., Cincinnati, O.

Bolt Forging Machine & Power Hammers a specialty. Send for circulars. Forsaith & Co., Manchester, N. H.

The Cameron Steam Pump mounted in Phosphor Bronze is an indestructible machine. See ad. back page.

Painters' Rapid Graining Process. J.J.Callow,Clev'd,O.

For Solid Wrought Iron Beams, etc., see advertisement. Address Union Iron Mills, Pittsburgh, Pa., for lithograph, etc.

Safety Linen Hose for factories, hotels, and stores, as protection from fire. Greene, Tweed & Co., 18 Park Place, N. Y.

John T. Noye & Son, Buffalo, N. Y., are Manufacturers of Burr Mill Stones and Flour Mill Machinery of all kinds, and dealers in Dufour & Co.'s Bolting Cloth. Send for large illustrated catalogue.

Power & Foot Presses, Ferracute Co., Bridgeton, N. J.

Solid Emery Vulcanite Wheels—The Solid Original Emery Wheel—other kinds imitations and inferior. Caution.—Our name is stamped in full on all our best Standard Belting, Packing, and Hose. Buy that only. The best is the cheapest. New York Belting and Packing Company, 37 and 38 Park Row, N. Y.

1,000 2d hand machines for sale. Send stamp for descriptive price list. Forsaith & Co., Manchester, N. H.

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Hydraulic Presses and Jacks, new and second hand. Lathes and Machinery for Polishing and Buffing metals. E. Lyon & Co., 470 Grand St., N. Y.

Sperm Oil, Pure. Wm. F. Nye, New Bedford, Mass.

Bound Volumes of the Scientific American.—I have on hand bound volumes of the Scientific American, which I will sell (singly or together) at $1 each, to be sent by express. See advertisement on page 318. John Edwards, P. O. Box 786, N. Y.

For Boult's Paneling, Moulding, and Dovetailing Machine, and other wood-working machinery, address B.C. Machinery Co., Battle Creek, Mich.

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NEW BOOKS AND PUBLICATIONS.

OLD HOMES MADE NEW. By William M. Woollett. Published by A. T. Bicknell & Co., New York city.

This is a collection of plans, exterior and interior views, illustrating the alteration and remodeling of several suburban residences. The object is to exhibit how buildings of the homely types commonly found in country towns may at small expense be converted into tasteful and even elegant structures. Many of Mr. Woollett's designs have been practically applied, and all are pleasing.

We have received the reports and awards of the Judges of Groups 21, 23, 24, 26, and 27 from the publishers, Messrs. J. B. Lippincott & Co., Philadelphia. The classes considered are Agricultural Machines, Medicine, Architecture, Plastic and Graphic Art, and certain machine tools. These documents will perhaps be useful as records of the Exposition; but as compared to what they might be, we scarcely think them of any particular value.

Notes & Queries

W. McE.—See answer 36, p. 155, vol. 37. —T. W.—From your description we are unable to judge. Possibly the ax, storm, or fire may have been the cause. —R. F. B.—See "Business and Personal" column, for addresses.—M. B. H.—You can find descriptions and details in Weisbach's "Mechanics and Engineering."—M. E. S.—You cannot find all the directions in a book. Bourne's "Catechism of the Steam Engine," and Forney's "Catechism of the Locomotive," contain useful information on the subject.—H. R. B.—See answer No. 6, issue of April 13.—J. T. E.—You do not send enough details to enable us to form a decided opinion, but we imagine that the area of the chimney or some of the flues is too small. A simple remedy would be to make the surroundings of the boiler fireproof.—E. S. R.—It will be better to use a non-metallic handle.—W. A. S.—See answer No. 19, p. 155, issue of March 9, 1878. For your purpose the core need not be a permanent magnet, but may be of soft iron.

(1) C. H. & Co. write: We are manufacturers of cream colored earthen ware. Please inform us what to mix with the clay to have it a red color after it is burnt. A. Use a small quantity of red oxide of iron or red ocher.

(2) H. P. S. asks how to make an umbrella cover waterproof? A. Apply first a strong hot aqueous solution of soap, then solution of alum, sulphate of alumina, or lead acetate (sugar of lead); again the soap solution, and finally wash with hot water.

(3) W. D. S. asks: 1. Would it be possible for me to run hydrogen gas through the gas pipes of my house for lighting purposes instead of common illuminating gas? A. Hydrogen gas, when burning, gives a very pale bluish flame, insufficient for illuminating purposes. 2. Would there be any danger of the reservoir bursting, or could I keep it in the cellar safely? A. There would be danger. 3. How is hydrogen gas made? A. It is obtained in quantities by the action of dilute sulphuric acid upon scraps of iron or zinc contained in a large airtight vessel, connected by a pipe with the gas receiver, or by passing steam through red hot iron filings contained in an iron pipe, and collecting the gas over water.

(4) W. C. S. writes: Please give me a recipe for making a good quality of shoemakers' ink, to blacken the sole edges and heels of boots and shoes while damp, to be afterward polished with a hot iron made for the purpose. A. Dissolve an equal quantity each of ferrous sulphate (copperas) and gum arabic in a small quantity of boiling water, and add a very little extract of logwood solution. If it gums, dilute it a little with hot water. Concentrated solution of shellac in hot aqueous solution of borax is sometimes used in place of a portion of the gum.

(5) F. L. W. writes: The ceramic fever has led me to ask if there is any mode of transferring an engraving from the paper on which it is originally printed to any object, without requiring pressure to any great amount? A. Paper is prepared with bichromated gelatin, dried, and exposed to strong sunlight for some time beneath, and in contact with, a drawing or wood cut rendered translucent by oil (castor oil answers). The excess of chrome salt is removed by washing. The paper is then transferred, picture side down, to a plate of gypsum. A positive copy is thus obtained from a positive drawing, as only the unaltered gelatin sinks into the gypsum. By replacing the carbon of the ink with enamel colors designs can be printed on and burned into unglazed porcelain, etc.

(6) R. H. L. writes: I wish to etch broad letters and figures on glass by means of hydrofluoric acid gas. What wax or varnish is used which can be readily removed from the surfaces to be etched? A. Use beeswax or paraffin; warm the glass.

(7) C. A. A. writes: After the fruit is removed from peach cans we find the tin inside beautifully mottled like pearl. 1. Can this peculiar pearl-like mottle be given to common sheet tin artificially at a low cost? A. Wash the tin plate quickly with a mixture of 3 parts hydrochloric acid, 1 part nitric acid, and 3 parts water; rinse in water and dry with warm sawdust. The mother-of-pearl appearance—moire metallique—is preserved by a thin lacquer of pale shellac in alcohol. 2. Can the mottles be made small or large at will? A. No; their size depends in a great measure upon the rapidity with which the plate was cooled on leaving the tin bath.

(8) J. S. B. asks: Does the Jablochkoff electric candle throw out much heat? A. Compared with the illuminating power, the amount of heat radiated from the candle is relatively small.

(9) S. K. S. asks: What quantity and number of covered wire must I use to make the strongest horseshoe electro-magnet, having a ¾ inch core, using a Daniell battery of six cups, and what length should each coil be? A. Wind a sufficient quantity of No. 20 copper wire (magnet insulation) to make each spool 1⅛ inch in diameter and 3¼ inches long.

(10) C. W. asks: 1. How strong should telephone magnets be? A. They should be able to lift about their own weight of iron. 2. Should the spool wire touch the magnet? A. No; the core should be first covered with one or two layers of thin paper, and then wound with the insulated wire. 3. Will ferrotype plate answer for the disks? A. Yes. 4. Will two parallel cotton-covered wires, the size of fine sewing needles, laid close together, do to connect the instruments? A. Yes. 5. My instruments do not work, although I used about ½ oz. of No. 40 silk covered wire on each spool, the same length on both. A. Use more magnet wire wound in the manner mentioned in the answer to your second question, and see answer No. 19, p. 155, SCIENTIFIC AMERICAN of March 9, 1878.

(11) G. A. A. writes: I wish to run a steam pipe from a boiler to my house, a distance of 300 feet underground. What is the best non-conductor for packing the pipe, and how should it be laid? A. Asbestos is one of the best non-conductors, but is rather expensive. You can do pretty well by laying the pipe in a box, surrounded by coal ashes.

(12) F. H. M. asks: What is the rule for making a counterbalanced face wheel for engines? I had a crank engine (portable) that did not stand steady. The crank end of the connecting rod and fittings weigh 11 lbs., and the wrist pin 2 lbs. A triangular piece weighing 16 lbs. was put in the face wheel, which was said to be right, but it is no better than before. The engine is 6 x 12 inches, running 170 revolutions per minute. A. It is a common practice to place the counterweight directly opposite the crank, with its center of gravity at the same distance from the center of the shaft as the center of the crank pin, making its weight equal to weight of piston, piston rod, crosshead, and crank pin, plus half the weight of the connecting rod.

(13) C. H. S. asks: In fastening two pieces of wood with nails, which will make the stronger joining, to bore the outside piece, or force the nail through in the common way? A. The latter, we think.

(14) D. C. asks: How is the cold rolled shafting made so true as it is? A. By being passed through the rolls under heavy pressure.

(15) E. C. asks: 1. Which would be the best boiler to use for driving a thrashing machine, one built on locomotive style, or vertical? A. There is not a great deal of difference. There may possibly be a little advantage in the use of the locomotive type. 2. In running over rough roads with steam up, would there be any danger of explosion from turning and jolting? A. No. 3. Could an 8 horse power engine be moved with its own power without the use of horses to haul it? A. Yes.

(16) S. W. H. writes: A person here says that it takes 25 per cent more coal to make steam from water that is returned to the boiler from the steam radiators used in warming buildings, than if water from a river or well were used. Is it so? A. Ordinarily it is more economical to use the condensed steam from the radiators.

(17) G. F. P. writes: I think that a 2 horse power engine will give 4 horse power by connecting a 5 inch pulley on its main shaft to a 10 inch pulley on its driver shaft, by a belt, losing, of course, half the original speed. Is this correct? A. No.

(18) R. N. writes: J. C. can melt small quantities of brass easily in a common cylinder stove with a good draught, using hard coal, and setting the crucible well down into the fire. I have tried melting on the forge, and find this much easier and better.

(19) W. S. P. asks: How can I make a good quality of lemon sirup? A. Lemon juice (strained or defecated), 1 pint; sugar, 2½ lbs.; dissolve by gentle heat and set it aside; in 24 hours remove the scum and decant the clear liquid. The common soda water sirups are made by dissolving in a gallon of water 8 lbs. of sugar, 2 ozs. of gum arabic, and about ½ oz. of tartaric acid; strained through uncolored flannel, and flavored to suit with any of the fruit extracts or ethers.

(20) J. C. L. asks: Is steam visible before it comes in contact with the atmosphere? A. No.

(21) A. E. R. asks: 1. How can the power of the voice be increased? A. The effect, in public halls, may be increased by sounding boards and by attention to the laws of acoustics in constructing buildings; the actual power can only be increased by practice. 2. Will the phonograph make less demand for shorthand reporters? A. It may.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

G. M. P.—The specimen in the red box is a micaceous clay; might be useful to makers of wall papers.—J. F. K.—The talcose schist may be auriferous. The sample does not appear to be.—G. F. L.—No. 1 is brown hematite and shale. No. 2 has every appearance of being a slag. It gives the reactions for iron. No. 3 is lithographic stone.

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges with much pleasure the receipt of original papers and contributions on the following subjects:

Pendulum Experiment. By O. T.
Aerial Navigation. By H. C. H.
Quackery. By T. A.
Electrical and Acoustic Observations. By J. W. S.
Rapid Locomotive Building. By J. M. D.
Duration of Impressions on the Retina. By H. T.
Estimation of Sulphur in Organic Compounds. By W. W. I. and C. F.
The Metric System. By G. N. W.
Astronomic Discrepancies. By L. S. B.
Does the Sun Move?
New Optical Apparatus. By J. Y. C.
What is Life? By T. R. McC. and E. R. E.
A Brilliant Meteor. By R. D. S.

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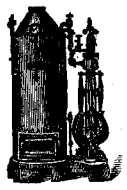

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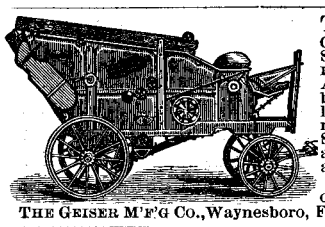

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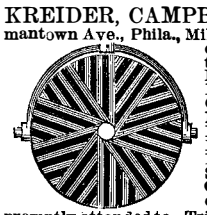

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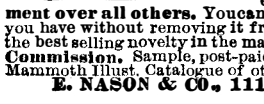

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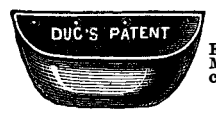

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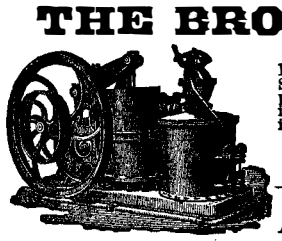

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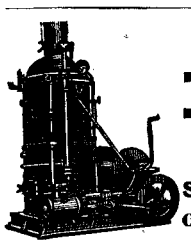

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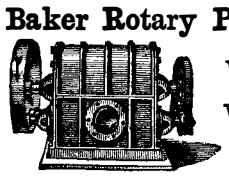

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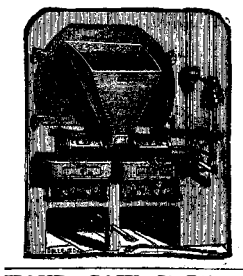

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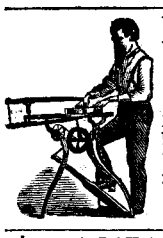

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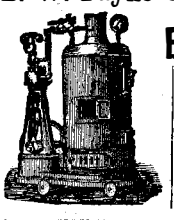

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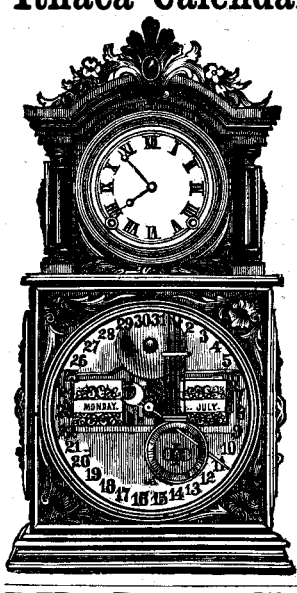

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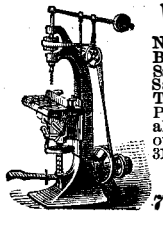

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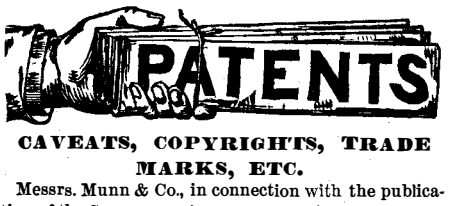

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